DRAFT
Supplemental Watershed Plan No. 7 & Environmental Assessment

for the

Rehabilitation of Floodwater Retarding Structure No. 77

of the Upper North River Watershed

Augusta County, Virginia

PREPARED BY

USDA Natural Resources Conservation Service

IN COOPERATION WITH
Augusta County Board of Supervisors
Headwaters Soil and Water Conservation District
USDA Forest Service

May 2015

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U.S. Forest Service

Authority

The original watershed work plan was prepared, and the works of improvement were installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534). The rehabilitation of Upper North River Dam No. 77 is authorized by under Public Law 83-566 (as amended), and as further amended by section 313 of Public Law 106-472.

Abstract

Upper North River Dam No. 77, Hearthstone Lake, does not presently meet Natural Resources Conservation Service (NRCS) or Virginia safety standards for the stability and capacity of the auxiliary spillway. The recommended plan is to rehabilitate Upper North River Dam No. 77 dam to meet current safety and design criteria. The plan provides for raising the dam embankment by 2.6 feet with earthfill, widening the auxiliary spillway by 92 feet, constructing a splitter dike, and installing turf reinforcement mat to enhance stability. The principal spillway riser will be upgraded to meet seismic criteria by completing a riser footer retrofit. There will be no change in the current levels of flood protection downstream as a result of project activity. Project installation cost is estimated to be $2,954,000 of which $2,102,000 will be paid from the Small Watershed Rehabilitation funds and $852,000 from local funds.

Comments and Inquiries

For further information, please contact: John A. Bricker, State Conservationist, USDA - Natural Resources Conservation Service, 1606 Santa Rosa Road, Suite 209, Richmond, Virginia 23229, Phone: (804) 287-1691.

UPPER NORTH RIVER WATERSHED AGREEMENT

Supplemental Watershed Plan Agreement
(Supplement No. 7)

between the

Augusta County Board of Supervisors
Headwaters Soil and Water Conservation District
(herein referred to collectively as "Sponsors")
Commonwealth of Virginia

and the

Natural Resources Conservation Service
United States Department of Agriculture
(herein referred to as "NRCS")

Whereas, the Watershed Work Plan Agreement for the Upper North River Watershed, Commonwealth of Virginia, authorized under the Flood Control Act of 1944 (Public Law 78-534, as amended) and executed by the Sponsors named therein and the Soil Conservation Service (which is now NRCS, pursuant to section 246 of the Department of Agriculture Reorganization Act of 1994, 7 U.S.C. 6862), became effective the 11th day of August 1960; and

Whereas, Supplement No. 1, which modified the Watershed Plan Agreement, was developed through cooperative efforts of the Sponsors and the Soil Conservation Service and became effective on the 17th day of October 1961; and

Whereas, Supplement No. 2, which modified the Watershed Plan Agreement, was developed through cooperative efforts of the Sponsors and the Soil Conservation Service and became effective on the 14th day of May 1962; and

Whereas, Supplement No. 3, which modified the Watershed Plan Agreement, was developed through cooperative efforts of the Sponsors and NRCS and became effective on the 18th day of March 1964; and

Whereas, Supplement No. 4, which modified the Watershed Plan Agreement, was developed through cooperative efforts of the Sponsors and NRCS and became effective on the 8th day of June 1993; and

Whereas, Supplement No. 5, which modified the Watershed Plan Agreement, was developed through cooperative efforts of the Sponsors and NRCS and became effective on the 18th day of April 2000; and

Whereas, Supplement No. 6, which modified the Watershed Plan Agreement, was developed through the cooperative efforts of the Sponsors and NRCS and became effective on the 30th day of August 2012; and

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for rehabilitation of the works of improvement for the Upper North River Dam No. 77 located in Augusta County, Commonwealth of Virginia, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Section 1001 to 1008, 1010, and 1012); and

Whereas, the responsibility for administration of the section 13 of the Flood Control Act of 1944 has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, through the cooperative efforts of the Sponsors and NRCS, a Supplemental Watershed Plan and Environmental Assessment has been developed to rehabilitate the Upper North River Dam No. 77, Commonwealth of Virginia, hereinafter referred to as the Watershed Project Plan or Plan, which Plan is annexed to and made a part of this agreement; and

Whereas, in order to provide for rehabilitation of the Upper North River Dam No. 77, it has become necessary to modify the Supplemental Watershed Plan Agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS and the Sponsors, hereby agree on this Supplemental Watershed Plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this Supplemental Watershed Agreement and including the following:

1. **Term.** The term of this agreement is for 70 years and does not commit the NRCS to assistance of any kind beyond the end of the agreement.

2. **Costs.** The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.

3. **Real property.** The Sponsors will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the Sponsors and NRCS are as shown in the Cost-Share table in Section 5 hereof. The Sponsor acknowledges the potential risk of flood damages for the real property between the flowage rights elevation and the top of dam elevation.

4. **Uniform Relocation Assistance and Real Property Acquisition Policies Act.** The Sponsors hereby agrees to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. 4601 et. seq. as further implemented through regulations in 49 C.F.R. Part 24 and 7 C.F.R. Part 21) when acquiring real property interests for this federally assisted project. If the Sponsors are legally unable to comply with the real property acquisition requirements, it agrees that, before any Federal financial assistance is furnished; it will provide a statement to that effect, supported by an

opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

5. **Cost-share for Rehabilitation Project.** The following table will be used to show cost-share percentages and amounts for Watershed Project Plan implementation.

Works of Improvement	**NRCS**		**Sponsors**		**Total**
Cost-Sharable Items	**Percent**	**Cost**	**Percent**	**Cost**	**Cost**
Rehabilitation of the dam (construction costs):	65%	$1,577,000	35%	$836,000	$2,413,000
Relocation, Replacement in-kind:	0%	$0	0%	$0	$0
Relocation, Required Decent, Safe, Sanitary:	0%	$0	0%	$0	$0
Sponsors' Planning Costs:	n/a	n/a	100%	$5,000	$5,000
Sponsors' Engineering Costs:	n/a	n/a	100%	$2,000	$2,000
Sponsors' Project Administration Costs:	n/a	n/a	100%	$6,000	$6,000
Land Rights Acquisition Costs:	n/a	n/a	100%	$0	$0
Subtotals: Cost-Sharable Costs: Cost-Share Percentages:[a/]	(65%)	**$1,577,000**	(35%)	**$849,000**	**$2,426,000** (100%)
Non Cost-Sharable Items (per PL-83-566 and NRCS policy)[b/]	---	---	---	---	---
NRCS Engineering and Project Administration Costs:	100%	$525,000	n/a	n/a	$525,000
Natural Resource Rights:	n/a	n/a	0%	$0	$0
Federal, State and Local Permits:	n/a	n/a	100%	$3,000	$3,000
Relocation, Beyond Required Decent, Safe, Sanitary	n/a	n/a	0%	$0	$0
Subtotals: Non-Cost-Sharable Costs:	**100%**	**$ 525,000**	**100%**	**$3,000**	**$528,000**
Total Cost-Sharable Cost:	**n/a**	**$1,577,000**	**n/a**	**$849,000**	**$2,426,000**
Total Installation Cost:	**n/a**	**$2,102,000**	**n/a**	**$852,000**	**$2,954,000**

a/ The maximum NRCS cost-share is 65% of the cost-sharable items not to exceed 100% of the construction cost. Total eligible project costs include construction, land rights, relocation, project administration, and planning services provided by the Sponsors.

b/ If actual non-cost-sharable item expenditures vary from these estimates, the responsible party will bear the change in costs.

6. **Land treatment agreements.** Approximately 99% of the drainage area above Upper North River Dam No. 77 is wooded with the remaining 1% in open space, hay/pasture, and open water. It is expected to remain as such. Therefore, there is no need for additional erosion

control measures in the watershed. Thus, there is no requirement for the Sponsors to obtain agreements for protection of the upstream watershed.

7. **Floodplain Management.** Before construction of any project for flood prevention, the Sponsors must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs.

8. **Water and mineral rights.** The Sponsors will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to State law as may be needed in the installation and operation of the works of improvement. Any costs incurred must be borne by the Sponsors and these costs are not eligible as part of the Sponsors' cost-share.

9. **Permits.** The Sponsors will obtain and bear the cost for all necessary Federal, State, and local permits required by law, ordinance, or regulation for installation of the works of improvement. These costs are not eligible as part of the Sponsors' cost-share.

10. **NRCS assistance.** This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the rehabilitation plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

11. **Additional agreements.** A separate agreement will be entered into between NRCS and the Sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. **Amendments.** This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may de-authorize or terminate funding at any time it determines that the Sponsors have failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS must promptly notify the Sponsors in writing of the determination and the reasons for de-authorization of project funding, together with the effective date. Payments made to the Sponsors or recoveries by NRCS must be in accordance with the legal rights and liabilities of the parties when project funding has been de-authorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the Sponsors having specific responsibilities for the measure involved.

13. **Prohibitions.** No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.

14. **Operation and Maintenance (O&M).** The Sponsors will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M agreement. An O&M agreement will be entered into before Federal funds are obligated and continue for the project

life (68 years). Although the Sponsors' responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the Sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.

15. **Emergency Action Plan.** Prior to construction, the Sponsors must prepare an Emergency Action Plan (EAP) for this dam where failure may cause loss of life, as required by state and local regulations. The EAP must meet the minimum content specified in NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. An EAP is required prior to the execution of fund obligating documents for rehabilitation of the structure. The EAP must be reviewed and updated by the Sponsors annually.

16. **Nondiscrimination provisions.** The U.S. Department of Agriculture (USDA) prohibits discrimination against its customers, employees, and applicants for employment on the bases of race, color, national origin, age, disability, sex, gender identity, religion, reprisal, and where applicable, political beliefs, marital status, familial or parental status, sexual orientation, protected genetic information, or if all or part of an individual's income is derived from any public assistance program, in employment or in any program or activity conducted or funded by the Department. (Not all prohibited bases will apply to all programs and/or employment activities.) Individuals who are deaf, hard of hearing or have speech disabilities, and who wish to file either an EEO or program complaint can contact USDA through the Federal Relay Service at (800) 877-8339 or (800) 845-6136 (in Spanish). Individuals who require alternative means of communication for program information (e.g., Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). USDA is an equal opportunity provider and employer.

    By signing this agreement, the recipient assures the U.S. Department of Agriculture that the program or activities provided for under this agreement will be conducted in compliance with all applicable Federal civil rights laws, rules, regulations, and policies.

17. **Certification Regarding Drug-Free Workplace Requirements** (7 CFR Part 3021). By signing this watershed agreement, the Sponsors are providing the certification set out below. If it is later determined that the Sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

    Controlled Substance means a controlled substance in Schedules I through V of the Controlled Substances Act (21 U.S.C. Section 812) and as further defined by regulation (21 CFR Sections 1308.11 through 1308.15);

    Conviction means a finding of guilt (including a plea of *nolo contendere*) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

Criminal drug statute means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

Employee means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant; and, (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the grantees' payroll, or employees of sub-recipients or subcontractors in covered workplaces).

Certification:

A. The Sponsors certify that they will or will continue to provide a drug-free workplace by:

(1) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.

(2) Establishing an ongoing drug-free awareness program to inform employees about—

(a) The danger of drug abuse in the workplace;

(b) The grantee's policy of maintaining a drug-free workplace;

(c) Any available drug counseling, rehabilitation, and employee assistance programs; and

(d) The penalties that may be imposed upon employees for drug abuse violation occurring in the workplace.

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1);

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee will--

(a) Abide by the terms of the statement; and

(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction.

(5) Notifying the NRCS in writing, within ten calendar days after receiving notice under paragraph (4) (b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice must include the identification number(s) of each affected grant.

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employees who is so convicted--

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(b) Requiring such employee to participate satisfactorily in drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

B. The Sponsors may provide a list of the site(s) for the performance of work done in connection with a specific project or other agreement.

C. Agencies will keep the original of all disclosure reports in the official files of the agency.

18. Certification Regarding Lobbying (7 CFR Part 3018)

A. The Sponsors certify to the best of their knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the Sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned must complete and submit Standard Form – LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The Sponsors must require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients must certify and disclose accordingly.

B. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction

imposed by Section 1352, Title 31, of the U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

19. Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions (7 CFR Part 3017).

A. The Sponsors certify to the best of their knowledge and belief, that they and their principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (A)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

B. Where the primary Sponsor is unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20. Clean Air and Water Certification

A. The project Sponsoring organizations signatory to this agreement certify as follows:

(1) Any facility to be utilized in the performance of this proposed agreement is (__), is not (_X_) listed on the Environmental Protection Agency List of Violating Facilities.

(2) To promptly notify the NRCS State Administrative Officer prior to the signing of this agreement by NRCS, of the receipt of any communication from the Director, Office of Federal Activities, U.S. Environmental Protection Agency, indicating that any facility which is proposed for use under this agreement is under consideration to be listed on the Environmental Protection Agency List of Violating Facilities.

(3) To include substantially this certification, including this subparagraph, in every nonexempt subagreement.

B. The project Sponsoring organizations signatory to this agreement agree as follows:

(1) To comply with all the requirements of section 114 of the Clean Air Act as amended (42 U.S.C. Section 7414) and section 308 of the Federal Water Pollution Control Act (33 U.S.C. Section 1318), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, issued there under before the signing of this agreement by NRCS.
(2) That no portion of the work required by this agreement will be performed in facilities listed on the EPA List of Violating Facilities on the date when this agreement was signed by NRCS unless and until the EPA eliminates the name of such facility or facilities from such listing.
(3) To use their best efforts to comply with clean air standards and clean water standards at the facilities in which the agreement is being performed.
(4) To insert the substance of the provisions of this clause in any nonexempt subagreement.

C. The terms used in this clause have the following meanings:

(1) The term "Air Act" means the Clean Air Act, as amended (42 U.S.C. Section 7401 et seq.).
(2) The term "Water Act" means Federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et seq.).
(3) The term "clean air standards" means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 of the Air Act (42 U.S.C. Section 7414) or an approved implementation procedure under section 112 of the Air Act (42 U.S.C. Section 7412).
(4) The term "clean water standards" means any enforceable limitation, control, condition, prohibition, standards, or other requirement which is promulgated pursuant to the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. Section 1342), or by a local government to assure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. Section 1317).
(5) The term "facility" means any building, plant, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a Sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location will be deemed to be a facility except where the Director, Office of Federal Activities,

Environmental Protection Agency, determines that independent facilities are collocated in one geographical area.

21. Assurances and Compliance. As a condition of the grant or cooperative agreement, the Sponsors assure and certify that they are in compliance with and will comply in the course of the agreement with all applicable laws, regulations, Executive orders and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as specifically set forth herein.

State, Local, and Indian Tribal Governments: OMB Circular A-87, A-102, A-129, and A-133; 7 CFR Parts 3015, 3016, 3017, 3018, 3021, and 3052.

Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021, and 3052.

22. Examination of Records. The Sponsors must give the NRCS or the Comptroller General, through any authorized representative, access to, and the right to, examine all records, books, papers, or documents related to this agreement, and retain all records related to this agreement for a period of three years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

Augusta County Board of Supervisors
Augusta County Government Center
18 Government Center Lane
Verona, Virginia 24482

By: _____
PATRICK J. COFFIELD

Title: County Administrator

Date: _____

The signing of this supplemental watershed agreement was authorized by the governing body of the Augusta County Board of Supervisors at a meeting held on _____.

_____
Clerk or Notary

18 Government Center Lane
Verona, Virginia 24482

Date: _____

Headwaters Soil and Water Conservation District

By: _____
RICHARD M. SHIFLET

Augusta County Government Center
USDA Building
70 Dick Huff Lane
Verona, Virginia 24482

Title: Chairman

Date: _____

The signing of this supplemental watershed agreement was authorized by the governing body of the Headwaters Soil and Water Conservation District at a meeting held on _____.

_____
Office Administrator

Augusta County Government Center
USDA Building
70 Dick Huff Lane
Verona, Virginia 24482

Date: _____

Natural Resources Conservation Service
United States Department of Agriculture

Approved by:

_____
JOHN A. BRICKER
State Conservationist

Date: _____

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APPENDICES

SUMMARY OF SUPPLEMENTAL WATERSHED PLAN NO. 7 AND ENVIRONMENTAL ASSESSMENT
for the
Rehabilitation of Upper North River Watershed Dam No. 77
Augusta County, Virginia
6th Congressional District

Prepared by: United States Department of Agriculture, Natural Resources Conservation Service and in cooperation with the United States Department of Agriculture, Forest Service.

Authorization: The original work plan was prepared, and the works of improvement were installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534). The rehabilitation of Upper North River Dam No. 77 is authorized under Public Law 83-566 (as amended), and as further amended by section 313 of Public Law 106-472.

Sponsors: Augusta County Board of Supervisors
Headwaters Soil and Water Conservation District

Proposed Action: Rehabilitate Upper North River Watershed Dam No. 77, Hearthstone Lake, to meet current NRCS safety and performance standards for a high hazard dam.

Purpose and Need for Action: The Upper North River Dam No. 77, Hearthstone Lake, does not currently meet NRCS safety and performance standards for a high hazard dam or Virginia Division of Dam Safety standards for the capacity of the vegetated earthen auxiliary spillway. There are lives and property downstream of this structure that need flood protection. The purposes for federal action are to meet current safety and performance standards for a high hazard dam and maintain flood protection for downstream properties.

Description of Preferred Alternative: The recommended plan will rehabilitate Upper North River Dam No. 77 dam to meet current safety and performance standards for a high hazard dam, provide sediment storage for an additional 68 years after construction, and maintain the current level of flood protection downstream. The plan provides for raising the dam embankment by 2.6 feet with earthfill, widening the auxiliary spillway by 92 feet, constructing a splitter dike, and installing turf reinforcement mat for stability. The principal spillway riser will be upgraded to meet seismic criteria by doing a riser footer retrofit. There will be no change in the current levels of flood protection downstream as a result of project activity

Resource Information:

Location: Latitude: 38.3938889 Longitude: -79.1611111

8-Digit Hydrologic Unit Number: 02070005

Climate and Topography: The watershed has a continental, humid, temperate climate, and is characterized by warm to hot summers and rather cold winters. Hearthstone Lake is located in the Ridge and Valley Physiographic Province. The topography ranges from steep mountain terrain to flat to gently sloping valleys.

Watershed Size: Upper North River Watershed = 67,961 acres
Drainage Area of Hearthstone Lake = 10,131 acres

Land Use: Woodland: 10,045.2 acres, 99.2%
Open Space: 62.6 acres, 0.6%
Hay/Pasture: 2.7 acres, 0.00%
Water: 20.5 acres, 0.2%

Land Ownership: Upstream of dam: 100% public (U.S. Forest Service)
Downstream of dam: 97.5% private, 2.5% public

Population and Demographics: According to the U.S. Census Bureau, the population of Augusta County as of July 1, 2013 was 73,912. Of the total population, about 93.1% (68,628) were white and 4.1% (3,057) were Black or African American. All other racial groups individually were 0.8% of the total population or less. Together, white and blacks made up 97.2% of the county's entire population. Hispanics of any race are the second largest minority group with 2.2%, or 1,608. "Other races" present constituted less than 1% of the Augusta County population.

The 2009-2013 Census estimates indicate that 89.3% of the 31,362 housing units within Augusta County were occupied. Of the occupied housing units, 80.9% were owner-occupied and 19.1% were renter-occupied. The state-wide occupancy rate for Virginia as a whole reported in the 2009-2013 estimates was 89.4% and the national figure was 87.5%. The state-wide and national rates for owner-occupancy were 89.4% and 87.5% respectively. Residential property values for the land and associated buildings downstream of the dam range between $50,000 and $400,000 with an average of about $150,000. The total value of residential property (structures and contents only, excluding land values) at risk below the dam is an estimated $22,195,000.

Augusta County residents are estimated to have had per capita incomes of $25,519 for the 2009-2013 period. Virginians reported per capita income of $33,493 for the 2009-2013 period, while the same figure for the entire United States was $28,155 for that same period. That makes the county per capita income figure for 2009-2013 at 76% of the state's level and 91% of the national figure.

Cultural Resources: Because the dam is on land managed by the U.S. Forest Service, the U.S. Forest Service agreed to take the lead on inventories and investigations of cultural resources and other responsibilities per Section 106 of the National Historic Preservation Act. U.S. Forest Service cultural resources staff completed database searches for any known cultural resources and ground surveyed the project area for evidence of archaeological and/or historical resources that had the potential to be impacted. A pedestrian survey was conducted throughout the entire project area. Subsurface testing was implemented in areas with high potential for encountering cultural resources. Consultation with the Virginia Department of Historic Resources (VDHR) was initiated in November 2014 by the U.S. Forest Service with the submission of a cultural resources reconnaissance report pertaining to the proposed Hearthstone Lake Dam rehabilitation project. On December 8, 2014, the VDHR indicated their concurrence with the U.S. Forest Service's finding of "*no historic properties affected"* for the proposed Hearthstone Lake dam project.

Highly Erodible Cropland: None exists in the watershed.

Threatened and Endangered Species: Since the dam is located in the George Washington and Jefferson National Forest, the U.S. Forest Service agreed to take the lead on investigations and inventories of endangered, threatened, and sensitive (TES) species and other responsibilities per the Endangered Species Act (ESA) and completed a Biological Evaluation (BE) and Biological

Assessment (BA) per U.S. Forest Service policy. The information that follows has been summarized from the BE/BA which can be found in Appendix E.

Only the Indiana Bat (*Myotis sodalis)* is known to occur or could be potentially affected by the proposed project. Despite the existence of potential bat habitat, during past and recent surveys, no Indiana bats have been seen in the project area. The proposed project will have no effect on any other federally listed or proposed species or their designated or proposed critical habitat. Likewise, primarily because there are no sensitive species or likely habitat present, the project will have no impact to any other identified sensitive species.

Wetlands: There are approximately 7.86 acres of fringe wetlands around the perimeter and 12.3 acres of open water wetlands associated with Hearthstone Lake. No additional wetlands were identified within the project area boundaries.

Resource Concerns Identified Through Scoping:

Item/Concern	Rationale
WATER	
Floodplain Management	No increase in flood levels.
Streams, Lakes, and Wetlands	The lake will be temporarily drained during construction.
Water quality	Erosion and sediment during construction, dissolved oxygen.
Water resources	Temperature and sediment during construction, anoxic layering during release.
AIR	
Air Quality	Temporary effects during construction.
PLANTS	
Forest resources	There is a proposed Wilderness Area; U.S. Forest Service does not own subsurface mineral rights that could affect borrow.
Invasive species	Ensure none are introduced during implementation.
Riparian areas	Impacted during construction.
ANIMALS	
Endangered and Threatened Species	Temporary effects during construction. Temperature – existing cold water release. Dam is a migration barrier and fragments habitat. Dam is a barrier to natural nutrient and sediment transport.
Migratory birds/Bald eagles/Golden eagles	Temporary effects during construction.
HUMAN	
Costs/ National Economic Development (NED)	Net Economic Development must be considered.
Environmental Justice and Civil Rights	No disparate treatment is anticipated.
Local and Regional Economy	Temporary positive effect during construction for local and regional construction companies. Permanent negative effect if decommissioned.
Public health and safety	Dam is critical to the Town of Bridgewater. Restricted access during construction.
Public recreation	Temporary impacts for loss of use of lake and nearby trails during implementation.
Scenic beauty	Temporary impacts while lake is drawn down and unsightly construction equipment. If visual changes planned, need to meet U.S. Forest Service Forest Plan.
Social issues	How we prioritize public funds? Is it the role of government to use public funds to protect from flooding?

Alternative Plans Considered: There are two plans that were considered and evaluated in detail:

1) *No Federal Action (Sponsors' Rehabilitation)*

2) *Structural Rehabilitation with Federal Assistance – Widen auxiliary spillway by 92 feet, raise top of dam by 2.6 feet, enhance surface stability with Turf Reinforcement Matting (TRM), retrofit principal spillway riser, and install splitter dike (NED Alternative).*

The Sponsors have indicated that they will use the plan developed by NRCS to complete the rehabilitation of the dam in the event that Federal funding is not available. The *No Federal Action (Sponsors' Rehabilitation)* alternative would be the same or involve the same components as the *Structural Rehabilitation with Federal Assistance*. This alternative maximizes net benefits with a benefit/cost ratio of 1:1, and is the rehabilitation alternative preferred by the Sponsors.

Project Costs (Dollars)

	PL-83-566 Funds		**Other Funds**		**Total**	
Category	**Dollars**	**%**	**Dollars**	**%**	**Dollars**	**%**
Construction	$1,577,000	65%	$836,000	35%	$2,413,000	100%
Engineering	$475,000	99.6%	$2,000	0.4%	$477,000	100%
Relocation	n/a	n/a	n/a	n/a	n/a	n/a
Real Property Rights	n/a	n/a	$0	100%	$0	100%
Project Administration	$50,000	89.3%	$6,000	10.7%	$56,000	100%
Other (permits)	$0	0%	$3,000	100%	$3,000	100%
TOTAL COSTS	**$2,102,000**		**$847,000**		**$2,949,000**	
Annual O&M (non-Federal)	n/a	n/a	$5,000	100%	$5,000	100%

Project Benefits: Rehabilitation reduces the potential for loss of life and maintains protection of existing infrastructure downstream of the dam as well as property values around the lake and associated recreational opportunities. Net average annual equivalent benefits between the Future with Federal Project (FWFP) and the Future without Federal Project (FWOFP) = $0. This is due to the fact that the candidate plans to rehabilitate Hearthstone Lake are identical in scope, substantially equivalent costs and equal effects.

Number of Direct Beneficiaries: On-site – 1,800; Off-site – 630 residents and 1,000 people in vehicles daily

Other beneficial effects:

- Minimizes the threat to loss of life to approximately 630 people that live in the 225 homes within the breach inundation zone and to an additional 1,000 people daily who are travelling on the roads.
- Provides protection for approximately 740 vehicles on a daily basis that utilize Stokesville Road (520 vehicles), Towers Road (190 vehicles), and Reeves Road (30 vehicles).
- Provides recreational benefits to approximately 1,800 people.
- Minimizes the threat of loss of access and loss of emergency services for residences, businesses structures, clubs, and churches.
- Provides downstream flood protection for the residents in the area, as well as those working, recreating, or traversing within the downstream floodplains, for an additional 75 years.

- Eliminates the liability associated with continuing to operate an unsafe dam.
- Maintains existing stream habitat downstream of the dam.
- Retains the existing aquatic and terrestrial habitat in and around the lake.
- Leverages federal resources to install the planned works of improvement.
- Will meet current NRCS safety and performance standards for a high hazard dam

Benefit to Cost Ratio (current rate): 1.0 to 1.0

Net beneficial effects (NED): $0

Funding Schedule: The most likely scenario, assuming that funding continues, is for funds to be authorized within one fiscal year (budget authorization/allocation year), and for the project to be implemented over two years including one year for development of the design and one year for construction.

Federal funds: Year 1 - $375,000 for engineering and project administration; **Year 2** - $150,000 for construction supervision and project administration and $1,577,000 for construction;

Non-Federal funds: Year 1 - $1,000 for engineering and **$3,000** for permitting costs; **Year 2** - $7,000 for engineering and project administration and $836,000 for construction;

Period of Analysis: 70 years (includes 1 year for design and 1 year for construction)

Project Life: 68 years

Environmental Effects/Impacts:

Resource	Impact
Air Quality	Temporary increase in particulate matter on site during construction.
Land Use Changes	No effect.
Floodplains	Current floodplain would be maintained.
Fisheries	The lake will be drained for 6-8 months during construction. After restocking, full recovery is expected in two to four years.
Wildlife Habitat	No effect.
Wetlands	Temporary effects during construction on 12.3 acres of open water wetland and 7.86 acres of fringe wetland because lake will be drained.
Prime Farmland	N/A
Cultural Resources	No effect.
Threatened and Endangered Species	No effect.
Mitigation	No compensatory mitigation is needed.

Major Conclusions: In order to bring this dam into compliance with NRCS safety and performance standards for a high hazard dam and State safety criteria, it is necessary to raise the dam height, widen and protect the earthen auxiliary spillway, install a splitter dike and retrofit the riser. The majority of the environmental impacts are short-term (only during construction) and existing conditions will be restored upon completion of construction.

Areas of Controversy: None

Issues to be Resolved: None

Evidence of Unusual Congressional or Local Interest: No

Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects? Yes _X_ No ___

CHANGES REQUIRING PREPARATION OF A SUPPLEMENT

This supplement only addresses Upper North River Dam No. 77, known locally as Hearthstone Lake. This dam was built in 1966 as a high hazard dam. Due to changes in evaluation criteria, this dam does not meet current USDA Natural Resources Conservation Service (NRCS) safety and performance standards for a high hazard dam or Virginia Department of Conservation and Recreation, Division of Dam Safety and Floodplain Management (referred to herein as the Virginia Division of Dam Safety) dam design, safety, and performance standards for auxiliary spillway stability and capacity. A conditional certificate for Operation and Maintenance of the structure was issued by the Virginia Division of Dam Safety because the vegetated earthen auxiliary spillway cannot pass the Probable Maximum Flood (PMF) without overtopping the dam. For this reason, the dam does not meet the objectives of the Augusta County Board of Supervisors and the Headwaters Soil and Water Conservation District (Headwaters SWCD) (herein referred to as Sponsors), which are to continue to provide flood protection and to reduce the risk of loss of human life.

This supplemental plan documents the planning process by which NRCS provided technical assistance to the local Sponsors and the public in addressing resource issues and concerns within the Hearthstone Lake watershed. The dam is located in the George Washington and Jefferson National Forests. The plan was prepared with the assistance of the USDA Forest Service, George Washington and Jefferson National Forests, referred to herein as the U.S. Forest Service.

The recommended plan is to rehabilitate the Hearthstone Lake dam to meet current NRCS safety and performance standards for a high hazard dam. The plan provides for widening the auxiliary spillway by 92 feet and raising the top of the dam by about 2.6 feet with earthfill. The control section will be lengthened to 70 feet. An earthen splitter dike will be installed down the centerline of the auxiliary spillway to reduce the potential for concentrated flows. Turf Reinforcement Matting will be used to augment the vegetation in the auxiliary spillway. The existing principal spillway riser will be retrofitted to meet current criteria. There will be no change in the current levels of flood protection downstream as a result of project activity.

PURPOSE AND NEED FOR ACTION

The Upper North River Dam No. 77, Hearthstone Lake, does not presently meet NRCS or Virginia Division of Dam Safety standards for the stability and capacity of the vegetated earthen auxiliary spillway. There are lives and property downstream of this structure that need flood protection. The purpose of this action is to continue to provide 100-year flood protection in a manner that minimizes risk of loss of human life and is both cost effective and environmentally acceptable.

ORIGINAL PROJECT

In 1960, the original watershed work plan for flood prevention and watershed protection was prepared under the authority of the Flood Control Act of 1944 (Public Law 534). The works of improvement were subsequently installed under the same authority. The rehabilitation of Upper North River Dam No. 77 is authorized by the Public Law 83-566, (as amended), and as further amended by section 313 of Public Law 106-472. The Shenandoah Valley Soil Conservation

District was the sole sponsor. The original watershed work plan included the construction of three single-purpose dams designed for a 50-year life, an accelerated land treatment program for watershed protection, and 12 miles of stream channel improvement. Todd Lake (Dam No. 10) was built in 1963 as a significant hazard structure. Elkhorn Lake (Dam No. 76) and Hearthstone Lake (Dam No. 77) were built as high hazard structures in 1965 and 1966, respectively.

In 1961, the City of Staunton became a project sponsor and in 1962, the purpose of Elkhorn Lake was revised to include municipal water supply for the City of Staunton. A fourth flood control structure, Freemason Run (Dam No. 59), was added to the project in 1964 to provide protection of 162 acres of the floodplain. The Headwaters Soil and Water Conservation District and the Augusta County Board of Supervisors became project sponsors in 1993. These two sponsors then assumed responsibility for the operation and maintenance of Todd Lake and Hearthstone Lake. The dam on Freemason Run was not built due to geological faults in the area of the proposed dam site and the cost of relocating structures, roads, and utilities in the proposed flood pool. The channel work was also deleted from the planned works of improvement. The original watershed project was closed out and considered to be completed in April 2000. In 2012, NRCS completed a plan for the rehabilitation of Todd Lake as a high hazard structure. Construction on Todd Lake began in the spring of 2015.

WATERSHED PROBLEMS

The Sponsors were aware of potential problems with the Hearthstone Lake dam in 2007. From 2007 to 2013, the dam was operated under a grandfathered regular permit since there were changes in the dam safety regulations in 2008. In November 2011, the Virginia Division of Dam Safety issued a conditional certificate for Hearthstone Lake because the auxiliary spillway did not have sufficient capacity to pass the Probable Maximum Flood (PMF) without overtopping the dam embankment. The auxiliary spillway of Hearthstone Lake can only pass about 75% of the PMF.

Sponsor Concerns: A conditional certificate serves as notification to the Sponsors that the dam no longer meets State requirements and must be modified to meet State law. The presence of an unresolved conditional certificate leaves the Sponsors vulnerable to liability should the dam breach and downstream damages result. In January 2012, the Sponsors requested NRCS assistance to prepare a watershed plan that would identify the improvements necessary to obtain full dam safety certification.

Soil Erodibility: In 2012, the State commissioned Hurt and Proffitt to perform a Hazard Classification Study of Hearthstone Lake. Although the auxiliary spillway has performed satisfactorily for nearly 50 years, based upon the Hurt and Proffitt study, the capacity of the auxiliary spillway does not meet the required criteria for a high hazard dam. Further analysis indicated that the surface of the auxiliary spillway would be vulnerable to erosion in the PMF event. However, the integrity of the materials underlying the auxiliary spillway is sufficient to withstand the PMF flows.

Floodplain Management: The Sponsors have identified flooding in the floodplain downstream as a primary concern. Augusta County has participated in the National Flood Insurance Program since 1990, and realizes the value that Hearthstone Lake provides in flood protection benefits, particularly for the roads. Hearthstone Lake controls 15.83 square miles (10,131 acres) of the watershed above the affected properties and benefitted area. Rockingham County and the Town

of Bridgewater, which are located in the downstream end of the breach zone of the dam, also participate in the National Flood Insurance Program.

Erosion and Sedimentation: As of 2012, Hearthstone Lake had reached 46 years (92%) of its planned 50-year service life. The designed submerged sediment capacity was 150 acre-feet but the as-built volume was 193 acre-feet due to the removal of extra borrow removal from the pool area. As of 2012, there were 59 acre-feet of sediment in the pool area which is about 31% of the designed sediment storage volume. This material is primarily deposited sediments plus leaf and other organic debris. The upstream watershed of this lake is almost entirely forested and the sediment delivery is less than anticipated during the original design.

Local Concerns: The dams for Todd Lake, Elkhorn Lake, and Hearthstone Lake were planned and constructed in response to the concerns of the residents after the extensive flooding that occurred in 1949. The possibility of decommissioning the dam at Hearthstone Lake was mentioned at the first public meeting in April 2014 since it must be considered under the federal rehabilitation legislation. Representatives from Trout Unlimited had suggested removal of the dam to allow fish passage. Residents were adamantly opposed to decommissioning because of their concern that flooding would increase in the absence of the dam. According to a letter from the U.S. Army Corps of Engineers, dated May 1960, the North River experienced seven large floods in the period from 1870 to 1949. In 1985, the area experienced heavy rainfall from Hurricane Juan. This event was immediately followed by a tropical low that produced even higher rainfalls. These combined events caused flow in the auxiliary spillway of Hearthstone Lake to a depth of about 2 feet. Hurricane Fran, in 1996, caused over 5 feet of flow in the auxiliary spillway (Figure 1). There have been 13 other documented storm events that filled the flood pool but did not cause auxiliary spillway flow.

WATERSHED OPPORTUNITIES

The following is a general list of opportunities that will be recognized through the implementation of this dam rehabilitation plan. Some quantification of these opportunities will be provided in other sections of the report, as appropriate.

- Comply with high hazard dam safety and performance standards established by NRCS and the Virginia Division of Dam Safety.
- Minimize the potential for loss of life associated with a failure of this dam.
- Reduce the sponsor liability associated with operation of an unsafe dam.
- Maintain the existing level of flood protection for downstream homes and infrastructure.
- Protect real estate values downstream from the dam.
- Maintain aquatic and terrestrial habitats around the lake.
- Preserve existing recreation opportunities.

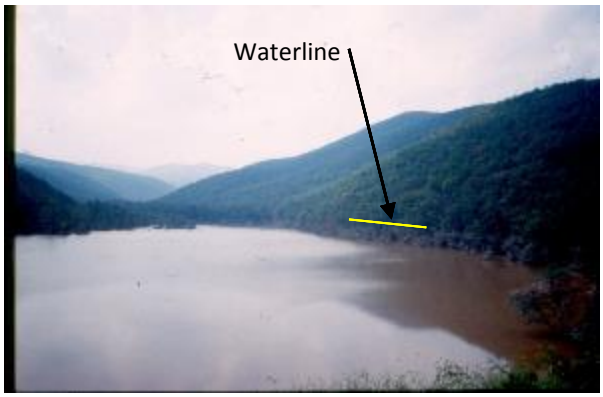

Figure 1. (Clockwise from top left) After Hurricane Fran in 1996 - the flood pool, the damaged hillslope downstream of the auxiliary spillway, and Tillman Road below the hillslope.

SCOPE OF THE ENVIRONMENTAL ASSESSMENT

A scoping process was used to identify issues of economic, environmental, cultural, and social importance in the watershed. Watershed concerns of Sponsors, technical agencies, and local citizens were expressed in the scoping meeting and in other planning and public meetings. Factors that would affect soil, water, air, plant, animals, and human resources were identified by an interdisciplinary planning team composed of the following areas of expertise: engineering, biology, economics, resource conservation, water quality, soils, archaeology, and geology.

On April 3, 2014, a Scoping Meeting was held at the Augusta County Government Office Complex in Verona, Virginia. Table A lists the specific concerns and their relevance to the proposed action to the decision making process. Input was provided by the Augusta County Administrator, the Headwaters SWCD, the Virginia Department of Emergency Management, Virginia Department of Health, Virginia Department of Game and Inland Fisheries, the Augusta County E-911 Emergency Communications Director, the U.S. Forest Service, the Town of Bridgewater, Trout Unlimited, and a representative from Virginia's 6th Congressional District Office.

The citizens at the first Public Meeting, also held on April 3, 2014, expressed concerns similar to those at the Scoping Meeting. After the meeting, NRCS received 43 letters of support for dam rehabilitation from residents of the Town of Bridgewater.

Table A - Scoping Meeting Results For Rehabilitation of Hearthstone Lake Dam
April 3, 2014

Item/Concern	Relevant to the Proposed Action		Rationale
	Yes	No	
SOILS			
Prime and Unique Farmland and farmland of statewide significance		X	None present.
Soil Resources		X	N/A
WATER			
Floodplain Management	X		No increase in flood levels.
Regional water resources plans (including coastal zone plans)		X	Watershed is in Chesapeake Bay drainage but not in a coastal zone management area. Local ordinances are in place to protect the Bay.
Sewer utilities		X	
Sole source aquifers		X	
Streams, Lakes, and Wetlands	X		The lake will be temporarily drained during construction.
Water quality	X		Erosion and sediment during construction, dissolved oxygen.
Water resources	X		Temperature and sediment during construction, anoxic layering during release
Wild & Scenic rivers		X	None present.
AIR			
Air Quality	X		Temporary effects during construction.
PLANTS			
Endangered and Threatened Species		X	None present.
Forest resources	X		There is a proposed Wilderness Area; U.S. Forest Service does not own subsurface mineral rights that could affect borrow availability for dam embankment modifications.
Invasive species	X		Ensure none are introduced during implementation.
Natural areas		X	
Riparian areas	X		Impacted during construction.

Item/Concern	Relevant to the Proposed Action		Rationale
	Yes	No	
ANIMALS			
Coral reefs		X	None present.
Ecologically critical areas		X	None present.
Endangered and Threatened Species	X		Potential habitat for Indiana bat in area. Consultation with US Fish and Wildlife Service will be conducted.
Essential fish habitat		X	None present.
Fish and wildlife	X		Temporary effects during construction. Temperature – existing cold water release. Dam is a migration barrier and fragments habitat. Dam is a barrier to natural nutrient and sediment transport.
Invasive Species		X	
Migratory birds/Bald eagles/Golden eagles	X		Temporary effects during construction.
HUMAN			
Costs/ National Economic Development (NED)/P&G	X		Net Economic Development must be considered.
Cultural resources		X	No adverse impacts to cultural resources.
Environmental Justice and Civil Rights		X	No disparate treatment is anticipated.
Land Use		X	No anticipated changes.
Local and Regional Economy	X		Temporary positive effect during construction for local and regional construction companies. Permanent negative effect if decommissioned.
Parklands		X	No parklands present.
Public health and safety	X		Dam is critical to the Town of Bridgewater. Restricted access during construction.
Public recreation	X		Temporary impacts for loss of use of lake and nearby trails during implementation.
Scenic beauty	X		Temporary impacts while lake is drawn down and unsightly construction equipment. If visual changes planned, need to meet U.S. Forest Service Forest Plan.
Scientific resources		X	There are no scientific resources identified in this area.
Social issues	X		How we prioritize public funds? Is it the role of government to use public funds to protect from flooding?

AFFECTED ENVIRONMENT

PLANNING ACTIVITIES

Geologic and engineering investigations and analyses were conducted by NRCS with assistance from the Headwaters Soil and Water Conservation District. This work included the sediment survey, the hydrologic and hydraulic analysis, and the Water Resources Site Analysis Program (SITES) analysis of the dam characteristics. Both the existing conditions and proposed rehabilitation alternatives were evaluated with these tools.

Other planning activities included a land use inventory, natural resources inventories, wetland assessments, and the identification of threatened and endangered species and fish and wildlife resources. The U.S. Forest Service conducted a Biological Assessment of the site. Cultural and historic resources were investigated and a Phase I survey completed. Potential alternatives were evaluated for cost-effectiveness and for local acceptability. Both the benefits and the costs of the alternatives were computed and analyzed.

PHYSICAL FEATURES

Project Location: The watershed for Hearthstone Lake is located in Augusta County, Virginia. The Hearthstone Lake watershed is 10,131 acres (15.83 square miles). Appendix B shows the location map for this watershed.

Topography: Hearthstone Lake is located in the Ridge and Valley Physiographic Province. The topography of the Ridge and Valley consists of long, relatively high ridges generally oriented in a northeast-southwest direction with continuous valleys in between. The elevation in the watershed ranges from about 1,880 feet at the dam to 4,351 feet at Little Bald Knob on the watershed divide.

Soils: The Hazleton-Lehew complex covers 73.0% of the watershed with 7,391 acres. Lehew soils cover 1,010 acres or 10.0% of the watershed; Hazleton soils cover 757 acres or 7.5%; Udorthents cover 488 acres or 4.8%; and Leetonia soils cover 460 acres or 4.5%. Water covers about 0.1% of the watershed (12.3 acres) and other soils account for another 0.1%. Approximately 81.2% of the soils in the watershed are on slopes greater than 25%. (For more information, see the Web Soil Survey at http://websoilsurvey.nrcs.usda.gov/.)

Geology: The digital representation of the 1993 Geologic Map of Virginia shows that the majority of the watershed draining into Upper North River Site No. 77 is underlain by the Devonian Age Hampshire Formation. There is an area underlain by the Chemung Formation exposed by an anticlinal structure running northeast-southwest across the watershed. That same map shows the embankment itself to be underlain by the Mississippian Age Pocono Formation. A very small area in the headwaters of the watershed is also underlain by the Pocono Formation. The Hampshire Formation is described as a sandstone and interbedded fine-grained mudstone, with some conglomeratic sandstones. The Chemung Formation is described as sandstone and shale. The sandstone is described as fine-grained, thin- to thick-bedded, and the shale is described as fissile, clay shale. The Pocono Formation is described as a quartzitic sandstone, medium- to coarse-grained, locally conglomeratic, thick-bedded, resistant, interbedded with thin shale and a few very-thin coal beds.

Climate: In the Ridge and Valley Physiographic Province, the average temperature is 37° F in the winter and 74° F in the summer. The last frost of spring normally occurs in late April to early May

and the first frost in the fall occurs in mid to late October. This provides a growing season of approximately 190 to 231 days, depending on elevation. The average annual precipitation is about 41 inches. This precipitation is well distributed through the year with slightly larger amounts occurring in the summer months. The average total snowfall in the western part of Augusta County is 16.1 inches.

The prevailing winds in the watershed are southwesterly, blowing hardest from January to April, with usually a light to moderate breeze at all times of the year. Average wind speed is approximately nine miles per hour during this time.

LAND USE

The drainage area upstream of Hearthstone Lake is 10,131 acres. This area was derived from the Augusta County 2007 Elevation data, using the ArcGIS Hydrologic Analysis Tools. The Land Cover/Land Use was extracted from the 2006 National Land Cover Dataset (NLCD). Within the drainage area, the Developed, Open Space is primarily the roads and boat landing area. Table B lists the land use upstream of the dam. This table also lists the land use in the Sunny Day Breach inundation zone below the dam. The land use in the Sunny Day Breach Zone was derived from the NLCD 2011 data set. Appendix B contains the aerial photograph of the watershed.

Table B - Land Use

Land Cover Type	Drainage Area of Hearthstone Lake (ac.)	Percent of Total	Sunny Day Breach Inundation Zone (ac.)	Percent of Total
Barren Land	-	-	0.4	0.0
Cultivated Crops	-	-	944.5	17.6
Forest	10,045.2	99.2	1,459.4	27.2
Developed, Low Intensity	-	-	89.0	1.7
Developed, Medium Intensity	-	-	18.7	0.3
Developed, High Intensity	-	-	4.9	0.1
Developed, Open Space	62.6	0.6	260.2	4.9
Hay/Pasture	2.7	0.0	2,554.7	47.6
Open Water	20.5	0.2	33.6	0.6
Total	**10,131.0**	**100.0**	**5,365.4**	**100.0**

THREATENED AND ENDANGERED SPECIES

Since the dam is located in the George Washington and Jefferson National Forest, the U.S. Forest Service agreed to take the lead on inventories and investigations of threatened and endangered (T&E) species for compliance with the Endangered Species Act and take the lead on any Section

7 consultation if necessary. The U.S. Forest Service prepared a Biological Evaluation/Biological Assessment (BE/BA) for the Hearthstone Lake Dam rehabilitation project in accordance with U.S. Forest Service Policy. The objectives of the BE/BA are to: 1) ensure that NRCS and Forest Service actions do not contribute to trends toward federal listing; 2) comply with the requirements of the Endangered Species Act (ESA) so that federal agencies do not jeopardize or adversely modify critical habitat (as defined in ESA) of federally listed species; and 3) provide a process and standard to ensure that threatened, endangered, proposed, and sensitive (TES) species receive full consideration in the decision-making process. The best available science was used to meet these objectives. The following information is a summary of the methods, results, and conclusions of the BE/BA. The BE/BA is contained in Appendix E for detailed review and analysis.

The U.S. Forest Service performed state and federal database searches, consulted with area experts, reviewed known ranges, and completed field surveys of the entire project area for federal and state listed TES species. The BE/BA concluded that no TES species were found, nor was there habitat that would likely support TES species other than the Indiana bat (*Myotis sodalis*). Despite the existence of potential bat habitat, during past and recent surveys, no Indiana bats have been seen in the project area. Public scoping did not identify any other TES species known to occur on the project area that would be affected. Therefore, it is unlikely that any other TES species routinely occurs in the project area. For these reasons, other TES species were eliminated from further consideration.

Since there are no other T&E species or likely habitat present, the proposed project will have no effect on any other federally listed or proposed species or their designated or proposed critical habitat, regardless of the alternative selected. Likewise, since there are no sensitive species or likely habitat present, the project will have no impact to any other sensitive state and federal species of concern. NRCS concurs with the findings of the U.S. Forest Service of no effect on TES and/or its associated habitat.

Confirmed occurrence of a listed species in a project area requires consultation with the appropriate state or federal agencies. Since there are no confirmed occurrences of federal or state listed threatened or endangered species in the project area, further consultation with TES regulatory agencies is not required.

CULTURAL RESOURCES, NATURAL AND SCENIC AREAS, AND VISUAL RESOURCES

The National Register of Historic Places lists fifty sites in Augusta County. Five archaeological sites within one mile of the project area are listed in the State archaeological files. However, none will be affected by the proposed work. There are no architectural sites listed in the State architectural files within one mile of the project area.

The National Historic Landmarks Program lists 119 sites, buildings or structures in Virginia, none of which are found in Augusta County. Therefore, none will be affected by the project activities. There are three designated State Natural and Scenic Area Preserves in Augusta County. However, none are within the project vicinity.

The U.S. Forest Service agreed to take the lead on inventories and investigations of cultural resources and other responsibilities per Section 106 of the National Historic Preservation Act. In October 2014, U.S. Forest Service cultural resources staff completed database searches for any

known cultural resources and ground surveyed the project area for evidence of archaeological and/or historical resources that had the potential to be impacted. A pedestrian survey was conducted throughout the entire project area. Subsurface testing was implemented in areas having high potential of encountering cultural resources. In addition, areas of high visibility were also examined. No known cultural resources were found from the database searches and no cultural resources were encountered during the field investigation for the project area.

Consultation with the Virginia Department of Historic Resources (VDHR) was initiated in November 2014 by the U.S. Forest Service with the submission of a cultural resources reconnaissance report pertaining to the proposed Hearthstone Lake Dam rehabilitation project. On December 8, 2014, the VDHR indicated their concurrence with the U.S. Forest Service's finding of "*no historic properties affected"* for the proposed Hearthstone Lake dam project.

WATER QUALITY

Hearthstone Lake is located on Little River which confluences with North River approximately 2.3 miles downstream of the dam. The watershed for Hearthstone Lake is almost entirely forested with the exception of a few meadows. The 2012 305(b)/303(d) Integrated Water Quality Assessment and Impaired Waters Report listed Little River as Category 5 waters needing a Total Maximum Daily Load Study addressing both aquatic life and recreation (VDEQ 2012).

STREAMS, LAKES, AND WETLANDS

Little River is a tributary to North River. The North River drains into the South Fork Shenandoah River which joins the North Fork Shenandoah River at Front Royal to become the Shenandoah River. The Shenandoah River drains into the Potomac River at Harper's Ferry, WV. The Potomac River flows into the Chesapeake Bay. Little River has a base flow of about 15.8 cubic feet per second immediately below the dam. The stream is approximately 10 feet wide and less than two feet deep. The substrate of the streambed consists of sands and gravels. The riparian areas adjacent to Little River and Hearthstone Lake are predominately forested.

The Hearthstone Lake shoreline, inlet, and outlet were visually surveyed in April 2014 for wetlands. Approximately 7.86 acres of freshwater emergent wetlands were identified at the inflow of the lake. The 12.3 surface acres of the lake are considered to be open water wetlands. No other wetlands were identified upstream or downstream of the dam. Data found at the US Fish and Wildlife wetland mapper website: www.fws.gov/wetlands/Data/Mapper.html concurred with the field investigation.

Additional documentation regarding the methods used to make the field investigation can be found in Appendix D.

AIR QUALITY

Air quality in the area is satisfactory. Augusta County is not within a non-attainment area for ozone or particulate matter-2.5 ($PM_{2.5}$) according to the 2013 Virginia Ambient Air Monitoring Data Report.

FOREST RESOURCES

The U.S. Forest Service North River District staff completed a field vegetative survey of the project area in June and August of 2014. A summary of that survey found that oak species dominate the canopy layer. Other important species in the canopy layer include pines, maples, black gum, and tulip poplar. Common mid-story vegetation includes saplings of overstory trees, witch hazel and serviceberry. Some of the most common understory species in the forested areas include seedlings of woody species, mountain laurel, greenbrier, blueberries, ferns, and mosses. The open areas contain a variety of flowers, grasses, sedges and shrubs. Many are alien or invasive species. This mixture of vegetation is typical of acidic soils developed over sandstone and shale bedrock in the Ridge and Valley portion of the Appalachian Mountains.

WILDLIFE RESOURCES

The Upper North River Watershed is considered to be part of the Blue Ridge Mountains Ecoregion according to Virginia's Comprehensive Wildlife Conservation Strategy, 2005 (VDGIF). This Strategy lists 174 Species of Greatest Conservation Need in the Blue Ridge Mountains. While completing field surveys, the U.S. Forest Service North River District staff observed many animals and animal signs commonly found in such habitats, including white-tailed deer, woodpeckers, spiders, eastern chipmunks, and many species of warblers and other songbirds. The survey found only typical aquatic animals in area streams and in Hearthstone Lake including frogs, red-spotted newt, minnows, and leeches. Species not seen during the field survey, but possibly occur in the activity area based on habitat observed during the field survey include the Indiana Bat, Northern long-eared bat, and Sweet pinesap. See Appendix E for the Biological Evaluation for the Threatened, Endangered, and Sensitive Species.

MIGRATORY BIRDS

Hearthstone Lake is on the Atlantic Flyway - the migratory path of waterfowl, shorebirds, pelagic birds, and songbirds of the North American East Coast. Each fall, the Atlantic Flyway is filled with ducks, geese, brant, swans, hawks, eagles, and other migratory birds. Waterfowl and other birds make several stops on the flyway to rest, feed and drink before continuing their southern migration. In early spring, birds follow this path northward to their traditional nesting grounds.

CHESAPEAKE BAY AND COASTAL ZONE MANAGEMENT AREAS

The Upper North River Watershed eventually drains into the Potomac River, a major tributary to the Chesapeake Bay. As such, the dam rehabilitation efforts must consider impacts as required by the Chesapeake Bay Preservation Act. Augusta County and Rockingham County have adopted local land use plans and ordinances which incorporate water quality protection measures consistent with the Chesapeake Bay Act Regulations. The Upper North River Watershed is not located within the Virginia Coastal Zone Management Area.

SOCIAL AND ECONOMIC CONDITIONS

Hearthstone Lake has a watershed of 10,131 acres, all of which lie within the George Washington and Jefferson National Forest and Augusta County. A majority of the population at risk from a breach event live within Augusta County. Only five homes within the breach inundation zone are located within Rockingham County. There are 220 homes in Augusta County within the breach inundation zone. Less than 3% of the properties potentially affected by a breach event are within Rockingham County. Therefore, the social and economic conditions section will focus on Augusta County.

Population and Race: According to the U.S. Census Bureau, the population of Augusta County as of July 1, 2013, was 73,912 (up only marginally from 73,750 according to the 2010 Census, but 12.6% higher than the 65,615 estimated in the 2000 census of the population). Of the total population in the 2009-2013 American Community Survey 5-year estimates, about 93.1% (68,628) were white and 4.1% (3,057) were Black or African American. All other racial groups individually were 0.8% of the total population or less. Together, white and blacks made up 97.2% of the county's entire population. Hispanics of any race are the second largest minority group with 2.2%, or 1,608. All other races present constituted less than 1% of the Augusta County population with 1,903.

Age: The 2009-2013 Census projections from the American Community Survey (ACS) of the U.S. Census Bureau, indicate that the median age (middle point with ½ above and ½ below) of the population of Augusta County was 43.5 (up from 39 in 2000). The median age for the state of Virginia was somewhat lower at 37.5 years (37.3 for the entire nation). Residents in Augusta County that were 65 years old or older totaled 16.8% (12,416). These statistics compare to 12.6% for the State and 13.4% for the nation. Of the County population, 79.2% was over the age of 18. The same statistic for the state as a whole was 77.1%. Both the local and the state numbers are higher than the national average estimated at 76.3%.

Education: Approximately 84.2% of the residents in the County had a high school education or higher while the state-wide and national percentages for this were 87.5% and 86% respectively. Of the residents in the county that are 25 years of age or older, 41.5% have a high school diploma or have passed an equivalency test. About 42.6% of the County residents have some education beyond high school, including 13.2% with a bachelor's degree or higher and 6.6% with graduate or professional degrees. An additional 17.1% in the County have completed at least some college level work with 5.7% having obtained an associate degree. All of these numbers are well above the state-wide and national averages. State-wide and nationally, 25.2% and 28.1% respectively, of the population 25 years of age or older, has a high school diploma or equivalency.

Employment/Unemployment, Class of Worker and Commuter Status: There are 60,267 Augusta County residents who are 16 years of age or older according to the 2009-2013 ACS. Approximately 59.5% (35,859) of these people are considered in the labor force pool. About 94.4% of the civilian labor force in the County was employed according to the 2009-2013 ACS. About 3.3% of the civilian labor force in the County was unemployed according to the same source. The unemployment figure is lower than the unemployment rate projected from the 2009-2013 estimates for the state of Virginia as a whole which was 7.2%, and for the nation, which was estimated to be 9.7%.

Augusta County has a diverse and productive economy. According to the 2009-2013 ACS, five sub-sectors of the local economy employ the civilian workforce: management and related

professional occupations (30.0%); sales and office occupations (23.3%); production, transportation, and materials moving occupations (19.7%), service occupations (17.1%) and natural resources, construction, and maintenance occupations (9.9%). According to the same 2009-2013 American Community Survey, private wage and salary employment constitutes 76.7% of all employment in Augusta County.

Income: Median household income (householder and all others, related or not) estimated for the county for the 2009-2013 period was $52,027. This compares to $63,907 per year for the median household income calculated for the state of Virginia. The national figure for median household income per year estimated for the same period was $53,046. The median estimated household income for 2009-2013 for Augusta County was 81% of the state median and 98% of the national median household income.

Median family income (householder and all others that are related) in Augusta County for the 2009-2013 period was $60,614 compared to $48,579 per year for 2000[1]. The current figure is significantly less, approximately 79%, than the $76,754 in median family income for Virginia as a whole and almost 94% of the $64,719 reported for the entire United States for 2009-2013.

With respect to per capita incomes, Augusta County residents are estimated to have had per capita incomes of $25,519 for the 2009-2013 period. Virginians reported per capita income of $33,493 for the 2009-2013 period, while the same figure for the entire United States was $28,155 for same time period. That makes the county per capita income figure for 2009-2013 76% of the state's level and 91% of the national figure.

Poverty: According to the 2009-2013 Census estimates, Augusta County had 1,476 families living below the poverty level (7.2%), up from 801 families (4.2%) living below the poverty level in 2000. State-wide, 8% of Virginia's families had incomes below the poverty level during the 2009-2010 period, up from 7% in 2000. At the national level, 11.3% of the families were estimated to live below the poverty level for the period 2009-2013, up from 9.2% in 2000.

Housing: The 2009-2013 Census estimates indicate that 89.3% of the 31,362 housing units within Augusta County were occupied. Of the occupied housing units, 80.9% were owner-occupied and 19.1% renter-occupied. The state-wide occupancy rate for Virginia as a whole reported in the 2009-2013 estimates was 89.4% and the national figure was 87.5%. The state-wide rates for owner- and renter-occupancy were 67.3% and 32.7%, respectively. The national rates for owner- and renter-occupancy were 64.9% and 35.1%, respectively.

A total of 225 homes (188 single family homes, 28 mobile homes, 2 multi-family homes and 7 modular homes) are located in the projected breach inundation zone below the dam. Most of the homes are located in or near the Town of Stokesville. Most of the residential property downstream of the dam ranges between $50,000 and $400,000 in total value with an average of about $150,000. The total value of residential property (structures and contents only, excluding land values) at risk below the dam is an estimated $22,195,000.

Recreation: Hearthstone Lake provides recreation to fishermen and day visitors to the National Forest and the recreational facilities at the reservoir (Figure 2). It is highly valued by the local community. Other lake-based recreation activities associated with the reservoir include boating

[1] Median family income is consistently higher than median household income. This is because the household universe includes people who live alone. Their income would typically be lower than family income because by definition, a family must have two or more people.

and bird watching. An estimated average of 7-8 visitors/day use the reservoir for recreation from March through October. Much lower visitation occurs during the remainder of the year. The total estimated usage is about 1,800 people per year.

Figure 2. View of boat ramp at Hearthstone Lake.

DESCRIPTION OF EXISTING DAM

Current Condition of the Dam: The most recent visual inspection of the dam was conducted in late summer of 2014. The dam and auxiliary spillway have been well maintained with a good stand of grass and no woody vegetation on the embankment and auxiliary spillway. No erosion was observed on either the embankment or the auxiliary spillway. The camera survey of the principal spillway pipe was completed in October 2012 and showed no material deterioration. The slide gate at the base of the riser was last activated during the camera inspection.

Potential Dam Safety Deficiencies: The Virginia Division of Dam Safety issued a conditional use certificate for Hearthstone Lake because the vegetated earthen auxiliary spillway does not have the capacity to pass the Probable Maximum Flood (PMF) storm flow without overtopping the structure. During the evaluation process, NRCS verified this condition. NRCS further determined that the auxiliary spillway also does not meet the NRCS stability criteria for a vegetated spillway. The third identified concern is that the footer of the principal spillway riser does not meet the current NRCS seismic criteria.

Location and Layout: Upper North River 77 dam and reservoir are located in a narrow valley with steep ridges. It is adjacent to and upstream of an unpaved secondary road (Forest Service Road 101 – Tillman Road) (Figure 3). Earthfill was placed in the valley of Little River to create the embankment with the auxiliary spillway (ASW) excavated out of the left abutment. The existing ASW exits to a hillslope that drops about 75 feet to the valley floor on a 35 to 40% grade. The hillslope consists of sandstone, shale and siltstone. Tillman Road is located at the bottom of the hillslope and also traverses the downstream stability berm of the embankment. It presents

limitations to designing any type of structure that extends beyond the downstream toe of the hillslope or dam.

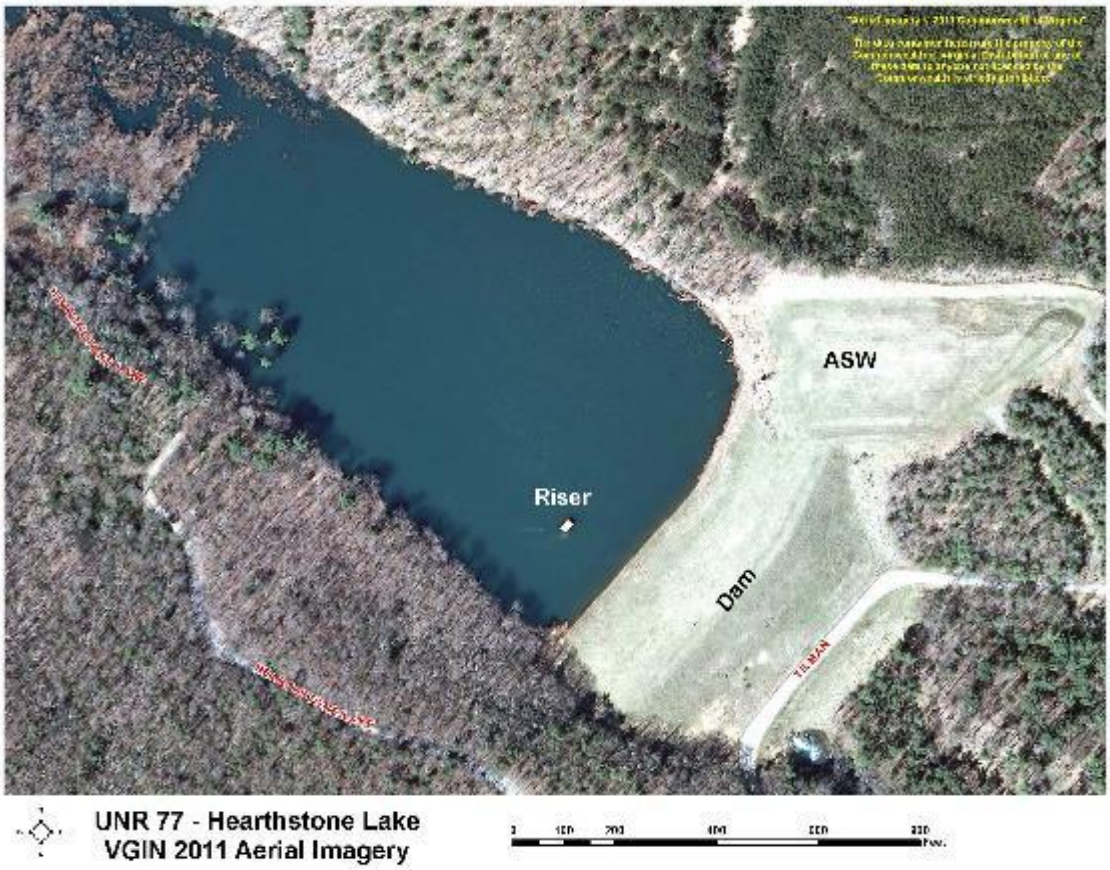

Figure 3. The Hearthstone Lake dam, auxiliary spillway, and pool.

As-Built Dam Specifications: The dam was completed in 1966. The earthfill used to construct the embankment was obtained from the permanent pool area, the auxiliary spillway excavation, and nearby borrow pits. According to the original design report, the pool borrow area included sand with fine gravel, silt, and boulders. The soils in the borrow areas were primarily silty clayey sand. The auxiliary spillway soils were fine sandy silts and silty sand.

The dam embankment is comprised of multiple zones or sections of earthfill. Section 1, the "Core" and cutoff trench material, is described as silts and clays. Section 2, the "Transition" material which wraps both the upstream side and downstream side of the core, is clayey sands and silty sand. Section 3, the "Shell," wraps the dam and creates the outside surface that is comprised of poorly graded gravels and silty gravels. Section 4 is located on the downstream side of the dam between the upper portions of Sections 2 and 3. It is comprised of siltstone and shale. The stability berm on the downstream side of the dam also serves as the rock toe drain labeled "Section 5" Rock Fill. This material was generated by rock excavation of the cutoff trench and auxiliary spillway. Sampling of the rock-filled toe was performed by Timmons Group and Schnabel Engineering in 2013.

The top of the embankment is 28 feet wide. The downstream embankment slope is 2 feet horizontal to 1 foot vertical (2:1). A 28-foot wide stability berm is located above the rock toe drain and also acts as the road bed for Tillman Road (Figure 4). The upstream face of the dam has a 3:1 side slope from the top of the dam to the wave berm. The slope continues at 3:1 below the elevation of the 10-foot-wide wave berm (Figure 5). The crest of the dam extends approximately 705 feet from the right abutment (looking downstream) to the ASW.

The site was surveyed in 2012 using NAVD88 vertical datum. The top of dam was surveyed at elevation 1856.1 (NAVD88) which is 107.3 feet above the downstream invert of the principal spillway pipe. There is a camber leaving the abutment contacts approximately 1 foot lower than the midpoint of the dam. The top of the dam varies from 1856.1 to 1854.9 (NAVD88).

Principal Spillway: The principal spillway consists of a 576-foot long, 48-inch-diameter, reinforced concrete pipe with 20 concrete anti-seep collars and a riprap-lined plunge pool (Figure 6). The existing concrete riser is a two-stage riser with a concrete top and a high stage trash rack. The inside riser dimensions are 4' x 12' and the riser walls are from 1.0 to 2.5 feet thick. The riser is 53.75' high (Figure 7). A 24" circular slide gate located on the right side of the riser allows controlled release of stored water through the riser. The riser controls the normal pool with an orifice at elevation 1778.0. The riser crest is at elevation 1801.8. A cold-water release was installed to control the temperature of the water released from the structure and to allow for an extended period of release during low flow conditions. The footing for the riser is 9' by 28.8' by 24" thick with a 2' by 2.5' wide buttress supports on both sides of the riser.

In 2000, the lake was drained for repairs to the drain gate and the external concrete of the riser. At a later time, a locked manhole cover was installed in the top of the riser.

Auxiliary Spillway: A 250-foot-wide vegetated earth auxiliary spillway was constructed in the left abutment (Figure 8). The As-Built drawings show a 30-foot-long level control section approximately 12 feet below the top of dam with a 130-foot long, 2% inlet slope. The constructed outlet has a grade of 2% for 380 feet. The vegetation lining the spillway is well maintained. The existing auxiliary spillway exits to a wooded hillslope that drops about 75 feet to the valley floor on a 35-40% grade. Spillway flows will pass over Tillman Road before entering the defined channel of Little River. The as-built elevation of the control section was 1844.0 and the 2012 mean surveyed elevation was 1843.4.

Hurricane Juan, in November of 1985, caused approximately 2 feet of flow in the auxiliary spillway but there was no damage to the auxiliary spillway. In September 1996, there was over 5 feet of flow in the auxiliary spillway from Hurricane Fran. There was no damage to the constructed outlet; however, the hillslope below the auxiliary spillway sustained some erosion at the upper end. The small gullies were filled with rock riprap and a diversion was installed at the end of the constructed auxiliary spillway to route water into the riprap areas.

Internal Drain System: At the time of construction, a rock toe drain was installed at the downstream toe of the dam. The drain is in good condition.

Figure 4. Back slope of dam and Tillman Road.

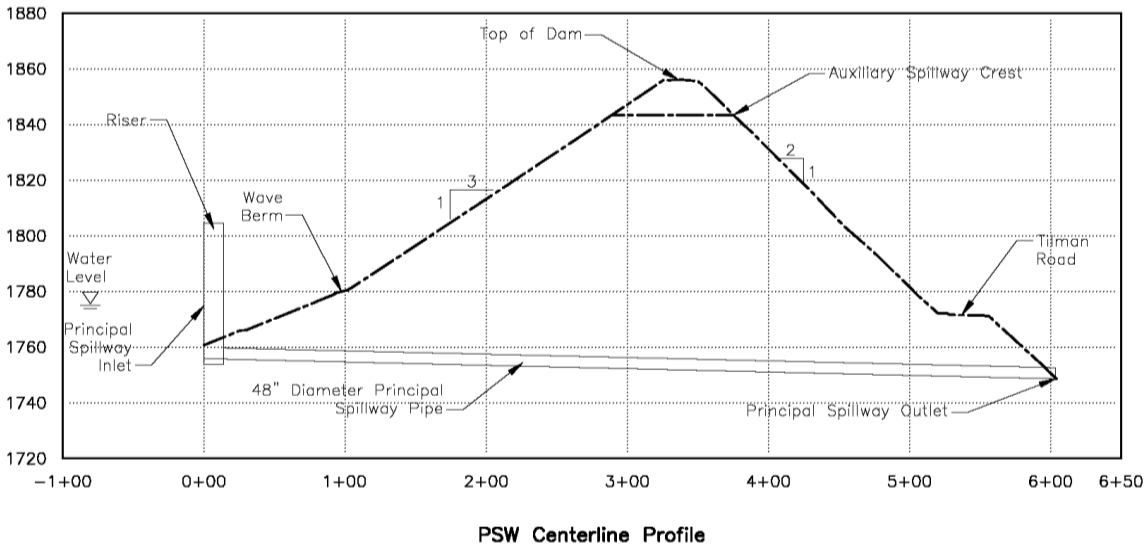

Figure 5. Cross-section of the Hearthstone dam.

Figure 6. Principal spillway outlet flowing into the plunge pool.

Figure 7. Principal spillway riser at Hearthstone Lake.

Figure 8. Auxiliary spillway, looking downstream.

Appurtenances: An Integrated Flood Observing and Warning System (IFLOWS) gauge installed in the embankment is used by Augusta County to remotely monitor water levels in the reservoir.

Sedimentation: Hearthstone Lake was designed to store 50 years of sediment in the pool area. The designed submerged sediment storage capacity was 150 acre-feet at a planned sediment accumulation rate of 3.0 acre-feet per year. Based upon the as-built cross-sections of the pool area, the original sediment storage capacity was 193 acre-feet. The volume of submerged sediment in the pool in 2012 was 59 acre-feet. In 2000, between 20 and 30 acre-feet of sediment were removed. The total submerged sediment volume accumulated between 1966 and 2012 was approximately 84 acre-feet. The sedimentation rate for this time period was 1.83 acre-feet per year. As of 2012, the remaining capacity of the sediment pool was 134 acre-feet. The land cover within the watershed is 99.2% forested and has not changed since the dam was constructed. The future sedimentation rate is projected to be the same as the historic rate. In 2012, there were 73 years of submerged sediment life remaining. Figure 9 shows the sediment survey in progress.

Due to the volume of sediment that has accumulated in the upper reaches of the pool, the surface area of the lake has decreased from 14 acres to 12.3 acres.

There were 130 acre-feet of aerated sediment storage planned. Aerated sediment is sediment that is deposited above the normal pool during high flows. The designed deposition rate for the aerated sediment was 2.6 acre-feet per year. The estimated volume of aerated sediment in the pool in 2012 was 13.8 acre-feet. This is an accumulation rate of 0.3 acre-feet per year. There is room for over 300 more years of aerated sediment deposition.

Construction Area and Construction Access

From Stokesville, Forest Service Road 95 (FR95) is paved to the intersection with FR101 (Tillman Road). From that point, Tillman Road is unpaved to the site. Access to the site can be achieved by the road that traverses the hillslope below the exit section of the auxiliary spillway. The access road can be widened for construction vehicles. Damage to Tillman Road that occurs as a result of construction will be repaired.

During construction, the contractor can stage operations within the auxiliary spillway. Additional clearing and grubbing will be required along the left side of the auxiliary spillway to accommodate the widening.

The potential construction zone is within the area included in the Special Use Permit that the U.S. Forest Service has issued to the Sponsors. This Special Use Permit would be renewed prior to construction.

Figure 9. Sediment survey, in progress.

GENERAL DESCRIPTION OF HOW A DAM FUNCTIONS

The main components of a flood control dam are the earthen embankment; the normal or sediment pool; the floodpool; the principal spillway; and the auxiliary spillway. The principal spillway controls the day-to-day elevation of the water in the lake and it provides a controlled release of the water in the floodpool. The floodpool, which is the water storage area between the principal spillway crest and the auxiliary spillway crest, is designed to detain the water that would accumulate behind the dam in events equal to or smaller than an event with a 100-year annual recurrence interval. This storm is the event that has a one percent chance of occurring in any given

year. In a bigger flood event, the water level will be higher than the crest of the auxiliary spillway and the excess water will pass around the dam embankment through the auxiliary spillway.

Sediment pool. The reservoir is designed to store sediment in the area below the elevation of the lowest principal spillway inlet and to detain floodwater in the area between the lowest principal spillway inlet and the crest of the auxiliary spillway. After the dam is completed, water accumulates below the lowest principal spillway inlet to create a lake. As the lake fills with sediment, the amount of water in the lake decreases. When the sediment pool has filled to the elevation of the lowest principal spillway inlet, the pool no longer has permanent water storage, but the designed floodwater detention storage is still intact. If the actual sedimentation rate is greater than the designed sedimentation rate, the sediment storage volume will be filled before the design life of the structure has been reached. The additional sediment would begin to fill the floodwater detention volume above the lowest principal spillway inlet and reduce the available flood storage. Initially, sediment delivered to the reservoir would pass directly through the lowest principal spillway inlet. Eventually, this inlet would be blocked by debris and sediment and water would be impounded to the elevation of the higher second-stage principal spillway crest. If the second-stage inlet becomes blocked, the level of the water would rise to the crest of the auxiliary spillway.

As the flood pool loses storage due to sediment deposition, the auxiliary spillway operates, or has flowage, more often. For a vegetated earthen auxiliary spillway, repeated flows could erode the soil material and eventually cause the spillway to breach. Repeated flows increase the operation and maintenance costs for the Sponsor.

Principal spillway: A principal spillway has three main parts: the riser, the pipe, and the outlet. The riser is typically a concrete tower that controls the level of water in the lake. Most risers have a drain gate at the bottom of the riser that allows the lake to be completely drained. The elevation of the water in the lake is determined by the amount of sediment that has to be stored over the life of the dam. For a two-stage riser, the water flows through the first-stage inlet in the riser until the water rises to the elevation of the second-stage inlet. Then, it flows through both inlets. The water falls to the bottom of the riser before exiting through the principal spillway pipe. The principal spillway pipe conveys water through the dam safely. The water exits into an outlet structure, typically called a stilling basin. Its purpose is to slow the velocity of the water leaving the pipe so it doesn't cause erosion in the stream channel.

Auxiliary spillway: There are four parts of an auxiliary spillway. The inlet section is on the side closest to the lake. It has a gentle upward slope toward the middle of the auxiliary spillway. The water that reaches the inlet section has little or no velocity and, therefore, does not cause erosion to occur. The level center section is called the control section. The control section is usually located where the auxiliary spillway crosses the centerline of the top of the dam. The purpose of the control section is to make the water in the auxiliary spillway spread out evenly rather than concentrate into little channels. The third section is called the constructed outlet. Its purpose is to keep the water flowing out of the auxiliary spillway in a controlled manner until the water gets far enough away that it will not cause erosion on the earthen embankment itself. Once this point is reached, the water is free to go on downstream. The fourth component of an auxiliary spillway is the training dikes. Training dikes are used in conjunction with the outlet section to direct the flow of the water away from the back side of the dam embankment. Training dikes can also be used in the inlet section to direct water into the auxiliary spillway.

STATUS OF OPERATION AND MAINTENANCE

Operation and maintenance of the structure is the responsibility of the Headwaters Soil and Water Conservation District and they have done an excellent job of operating and maintaining this structure in accordance with the operation and maintenance agreement. This has been verified through site assessments. The most recent inspection was conducted in the fall of 2014.

STRUCTURAL DATA

The structural data for the as-built condition of the dam and watershed is described in Table C. The sediment data is based upon the 2012 sediment survey.

BREACH ANALYSIS AND HAZARD CLASSIFICATION

Breach Analysis: To determine the downstream inundation zone due to a dam breach, a breach analysis was performed using a sunny day breach with the water level at the existing auxiliary spillway crest and following the peak breach discharge criteria in Technical Release No. 60, Earth Dams and Reservoirs (TR-60).

A maximum breach discharge of 241,300 cfs was computed using the criteria in TR-60. The depth of water at failure was about 87 feet. The computer models HEC-HMS and HEC-RAS (steady flow) were used to determine the inundation zone due to the breach of the dam. Results of the breach analyses are shown in Appendix C in Table C1 and on the Breach Inundation Map. The breach analysis terminates 30 miles downstream of the dam, where the flow from the breach would be within the regulated 100-year floodplain.

The Sponsors have current break inundation zone maps for the dam that comply with the Virginia Impounding Structures Law and Regulations for high hazard dams. These maps show the break inundation zone that would occur if the dam failed when the water level was at the top of the dam. The Virginia Impounding Structures Regulations requires owners of high hazard dams to provide a dam break inundation zone map to determine hazard classification and develop the Emergency Action Plan (EAP). The purpose of an EAP is to outline appropriate actions and to designate parties responsible for those actions in the event of a potential failure of the dam. The Sponsors will update the EAP annually with assistance from local emergency response officials. The NRCS State Conservationist will ensure that a current EAP is prepared prior to initiation of construction.

Hazard Classification: Hearthstone Lake was originally constructed in 1966 for the purpose of protecting downstream lands from flooding. It was designed as a Soil Conservation Service (SCS) class C (high hazard) structure with a 50-year design life. The hazard class of the structure is high because failure may cause loss of life and serious infrastructure damage. Currently, the Virginia Division of Dam Safety has designated Hearthstone Lake as a high hazard structure. The breach analysis completed for this Watershed Plan concurs with the original and current hazard class of the structure as high.

Table C – As-Built and Existing Structural Data for Hearthstone Lake

	As-Built	Existing
Local Name	Hearthstone Lake	
Site Number	77	
Year Completed	1966	
Cost	$558,525	
Purpose	Flood control	
Drainage Area, mi^2	16.01	15.83
Dam Height, feet	103.8	107.3[1/]
Dam Type	Earthen	
Dam Volume, yds^3	525,484	
Dam Crest Length, ft	705	
Storage Capacity, ac-ft [2/]	3,091	
Submerged Sediment, ac-ft	193	
Aerated Sediment, ac-ft	130	
Flood Storage, ac-ft	2,768	
Surface Area, ac.	14	12.3
Principal Spillway		
Type	Concrete	
Riser Height, ft	53.75	
Conduit Size, inches	48	
Stages, no.	2	
High-stage riser crest elev.	1802.2	1801.8
Capacity, cfs	447	
Energy Dissipater	Plunge Pool	
Auxiliary Spillway		
Type	Vegetated Earth	
Width, ft	250	
Capacity, % of PMF	100	75
Normal Pool Elev.	1778.2	1778.0
Flood Pool Elev.	1,844.0	1,843.4
Top of Dam Elev.	1,856.25	1,856.1
Datum	NGVD29	NAVD88

[1/] The change in dam height is due to a change in the way that the height is measured. The original height was measured from the toe of the embankment. To increase consistency in the measurement of the dam height, the invert of the outlet of the principal spillway pipe was considered to be at the toe of the embankment.

[2/] Volumes based on original design and as-built information.

EVALUATION OF POTENTIAL FAILURE MODES

Dams are built for the conditions that existed or could reasonably be anticipated during the time of design. Sometimes these conditions change, resulting in dam failure. Several potential modes of failure were evaluated for Hearthstone Lake.

Sedimentation: The land use in the watershed above the dam is 99.2% Forest, 0.6% Developed/Open Space, and 0.2% Water. Since the entire watershed is in the George Washington and Jefferson National Forest, these uses are not expected to change significantly. Also, the management of the lake is not expected to change. Unless there is a catastrophic event, such as a wildfire, the future sediment accumulation rate in Hearthstone Lake is expected to be the same as the historic rate. Based upon the future sediment deposition rate of 1.83 acre-feet per year, the remaining sediment storage life of Hearthstone Lake in 2015 was 70 years. Therefore, the potential for failure due to inadequate sediment storage capacity is low.

Hydrologic Capacity: Hydrologic failure of a dam occurs when the auxiliary spillway is breached or when the dam is overtopped and fails. Under present NRCS criteria for high hazard dams, the auxiliary spillway must have sufficient capacity and integrity to completely pass the full PMF event. The auxiliary spillway at Hearthstone Lake has sufficient integrity to withstand the flows from the PMF event but does not have the capacity to completely pass the design storm without overtopping the dam embankment. The water in the reservoir would flow over the top of the embankment and could cause it to erode and collapse. For this reason, the overall potential for hydrologic failure of Hearthstone Lake dam is considered to be high.

Seepage: Embankment and foundation seepage can contribute to failure of an embankment by removing (piping) soil material through the embankment or foundation. As the soil material is removed, the voids created allow even more water flow through the embankment or foundation, until the dam collapses due to the internal erosion. Seepage that increases with a rise in pool elevation is an indication of a potential problem, as is stained or muddy water or "sand boils" (the up-welling of sediment transported by water through voided areas). Foundation and embankment drainage systems can alleviate the seepage problem by removing the water without allowing soil particles to be transported away from the dam. There are no signs of seepage at the Hearthstone Lake dam. The potential for a seepage failure of Hearthstone Lake dam is considered to be low.

Seismic: The structural integrity of an earthen embankment are dependent upon the presence of a stable foundation. Foundation movement through consolidation, compression, or lateral movement can cause the creation of voids within an embankment, separation of the principal spillway conduit joints, or in extreme cases, complete collapse of the embankment. The Upper North River watershed is not located within an area of significant seismic risk; therefore, there is low potential for seismic activity to cause failure of the dam embankment.

However, the riser of the principal spillway at Hearthstone Lake does not meet the current NRCS criteria for seismic stability. Riser failure could have two different results. If the riser fails in a way that does not block the principal spillway pipe, then all of the water would drain out of the lake. This would eliminate the pool area but the dam would continue to provide flood storage. If a riser failure blocked the principal spillway pipe, the water would fill up to the crest of the auxiliary spillway and then flow through it. There would be no stormwater detention and no downstream flood protection. If this situation is not corrected, it could result in significant erosion of the auxiliary spillway over time. Although the potential for a seismic failure of the riser is low, this problem must be addressed during rehabilitation.

Material Deterioration: The materials used in the principal spillway system, the embankment drains, and the pool drainage system are subject to weathering and chemical reactions due to natural elements within the soil, water, and atmosphere. Concrete risers and conduits can deteriorate and crack, metal components can rust and corrode, and leaks can develop.

Embankment failure can occur from internal erosion caused by these leaks. In 2000, repairs were made to the concrete in the riser and the gate was replaced. A camera survey of the principal spillway pipe was conducted in October of 2012. No problems were observed with any of the material components. Therefore, there is low potential for failure due to material deterioration.

Conclusion: At the present time, the means of dam failure that is most likely to occur at Hearthstone Lake dam is erosion of the dam during an overtopping event. Water would overtop the dam as a result of insufficient hydrologic capacity in the auxiliary spillway. This type of failure could occur at any time during the remaining life of the structure. There is adequate sediment capacity, there are no signs of seepage and the site has minimal risk for failure due to material deterioration. Although the riser could be damaged in a seismic event, the risk of a dam failure in such an event is low.

CONSEQUENCES OF DAM FAILURE BY A SUNNY DAY BREACH

A sunny day breach analysis was performed in accordance with the peak breach discharge criteria in Technical Release No. 60, Earth Dams and Reservoirs (TR-60). It was assumed that structural collapse would occur with the water level at the existing auxiliary spillway crest and would result in a release of 2,970 acre-feet of water and sediment, beginning with a wall of water that is 87 feet high. A maximum breach discharge of 241,300 cfs was computed using the criteria in TR-60.

The population at risk is approximately 630 people. The properties and infrastructure potentially affected by a breach of the Hearthstone Lake Dam includes 225 homes, eight business structures, two recreational camps (Camp May Flather and a private hunt club), three churches, one steel truss bridge, two concrete deck bridges, and several culverts at two road crossings. Approximately 1.6 miles of U.S. Forest Service roads and associated culverts, 19 miles of several state roads, and 4 miles of private roads would be impacted by scour erosion damage.

Flows from a breach of Hearthstone Lake would pass through the communities of Stokesville and Mount Solon but would be within the 100-year floodplain of the North River before reaching the Town of Bridgewater. Traffic counts from the Virginia Department of Transportation (VDOT) indicate that an additional exposure to loss of life could occur as a result of the vehicles on 14 different state roads and 11 private roads. Average Daily Traffic (ADT) varies on these state roads from 190 to 920 vehicles per day. The utilities associated with the transportation routes could also be destroyed.

A breach event would cause significant economic damages to the homes, business structures, roads and bridges below the dam. In addition, the loss of the lake would result in a decrease in recreational opportunities with corresponding decreases in associated business activity. The residences and business properties at risk in the area of the floodplain subject to a breach of Hearthstone Lake have structure and content values estimated at $22,195,000 (land values excluded). A catastrophic breach would result in an estimated $15,785,000 in economic damages to existing buildings and their contents. The potentially impacted bridge, culvert, and road embankment infrastructure is valued at $13,980,000. Approximately $8,835,000 in damages to road crossings and roadbeds/embankments could occur in this event. A catastrophic breach of the Hearthstone Lake dam would result in a total estimated $24,620,000 in damages to homes, businesses, and infrastructure.

Other economic damages from a catastrophic breach would be associated public and private clean-up costs, damages to vehicles, lost recreation opportunities with the reservoir gone, and increased flood damages in the future for remaining properties due to the absence of the dam and its flood protection effects.

The environmental damages from a dam failure would be significant. In addition to the damage caused by the water, the sediment stored in the pool area would be flushed downstream in the event of a catastrophic breach. Approximately 11 miles of stream channel downstream of the dam would be damaged by scouring or deposition. Sediment would be deposited in the floodplain. This would constrict the floodplain and cause additional flooding in subsequent storm events. Deposition of sediment in the floodplain would also restrict normal use of the land which may cause water quality problems in the future. It is unlikely that a catastrophic breach would remove all of the fill material used to build the dam. The embankment material remaining after a breach would also eventually erode into the stream, contributing to the downstream sediment deposition. Over time, the sediment could migrate downstream from the North River into the Shenandoah River and then into the Potomac River.

There is also a potential for stream degradation upstream from the dam site. The abrupt removal of the water and sediment would cause instability in the stream feeding the reservoir. This channel could develop headcuts that would migrate upstream. If a bedrock ledge or other hardened point is encountered in the stream, the headcut would stop proceeding upstream. Downcutting and widening would continue to occur in the lake bed.

FORMULATION AND COMPARISON OF ALTERNATIVES

The stated objectives of the Sponsors for the Hearthstone Lake Rehabilitation Plan are: 1) to bring the Hearthstone Lake dam into compliance with current dam safety and design criteria; 2) to maintain the current level of flood protection provided by Hearthstone Lake; and 3) to address the local residents' concerns. These objectives can be met by installing measures which will bring the dam into compliance with State and Federal regulations. Under the Watershed Rehabilitation Provisions of the Watershed Protection and Flood Prevention Act, NRCS is required to consider the technical, social, and economic feasibility of the locally preferred solution and other alternatives identified through the planning process.

FORMULATION PROCESS

Formulation of the alternative rehabilitation plan for Hearthstone Lake followed procedures outlined in the NRCS *National Watershed Program Manual*. Other guidance incorporated into the formulation process included the NRCS *Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G),* and the *Economics Handbook, Part II for Water Resources,* and other NRCS watershed planning policies. There was only one alternative evaluated in detail. It had a 70-year period of analysis, which included a two year design and installation period and 68 years of expected useful life. It is anticipated that the dam will continue to be in service after that time with proper maintenance.

The formulation process began with formal discussions between the Sponsors, the Virginia Division of Dam Safety, and NRCS. The Virginia Division of Dam Safety conveyed state law and

policy associated with a high hazard dam. NRCS explained agency policy associated with the Small Watershed Dam Rehabilitation Program and related alternative plans of action. As a result, alternative plans of action were developed based on NRCS planning requirements and the ability of the alternatives to address the initial objective of bringing Hearthstone Lake into compliance with current dam safety and design criteria. The National Economic Development (NED) Alternative is the federally assisted alternative with the greatest net economic benefits. The alternative plans that must be considered include:

- No Federal Action
- Decommission the Dam
- Non-Structural – Relocate or Floodproof Structures in the Breach Zone
- Rehabilitate the Dam
- National Economic Development (NED) Alternative

ISSUES THAT MUST BE CONSIDERED IN EVALUATION OF ALTERNATIVES

Issue 1. Prevent a Breach of the Dam From Lack of Capacity. The capacity of the auxiliary spillway must be sufficient to pass the volume of the PMF event without overtopping the dam embankment. There are three main techniques for preventing a failure caused by overtopping the dam embankment. One solution is to raise the top of the dam. Another solution is to widen the auxiliary spillway. The third option is a combination of raising and widening. Lowering the crest of the auxiliary spillway is an option for increasing capacity but was not considered for this site because it would decrease the available flood protection.

Issue 2. Upgrade the Principal Spillway Riser to meet current NRCS criteria for seismic stability. At the completion of rehabilitation, all components of the dam must be in compliance with current criteria. The principal spillway riser could be brought into compliance with replacement or retrofitting.

Issue 3: Flatten the backslope of the dam to increase ease of maintenance. The back slope of the Hearthstone Dam was built with a slope of 2 feet horizontal to 1 foot vertical (2:1). The steepness of the slope precludes maintenance by mowing with the equipment currently owned by the Headwaters SWCD. Control of the woody vegetation is currently done with herbicides or by hand. As part of the rehabilitation planning, the Sponsors asked NRCS to consider flattening the slope to 2.5:1 or flatter to allow mowing.

The site-specific solutions to these issues are addressed in the section on Description of Alternative Plans Considered.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Some of the alternatives considered in the planning process were eliminated from detailed consideration because these alternatives either did not meet the proposed purpose or need for federal action or they were logistically impractical to implement.

Decommission Dam: Decommissioning is a mandatory alternative that must be considered under NRCS policy for dam rehabilitation. This option describes an alternative which requires removing the flood detention capacity of the dam by cutting a 100-foot wide notch in the existing

embankment down to the valley floor (Appendix C, Figure C2). If the dam is removed, the 237 homes, churches, clubs, and businesses in the breach zone will no longer be at risk from flooding caused by a breach of Hearthstone Lake. However, they would be at risk of uncontrolled flooding during storm events. Federal policy requires that induced damages be mitigated so that there would be no increase in the amount of damaged sustained during a 100-year flood event. The downstream bridges and utilities would have to be protected. The estimated cost of removing the storage capacity of the dam and all appurtenant structures is $6,887,200. When the cost of mitigation for induced damages is added, the total cost of this alternative would have an exorbitant cost.

Notching the dam embankment would require removal of about 277,000 cubic yards of material. The submerged and aerated sediment would be stabilized or removed. The function and stability of the stream channel would be restored. The removal of the principal spillway riser and pipe would also be necessary. These unneeded materials could be buried on site or hauled to an appropriate disposal site. About 36 acres of grass would be planted over the dam, pool, and spoil site. Table D lists some of the major components of decommissioning the dam.

Table D – Major Components of Decommissioning the Dam

Items of Work	Quantities	Unit cost	Cost
Fill removal and disposal	277,000 CY	$7.76/CY	$2,149,500
Spoil Spreading	290,850 CY	$9.09/CY	$2,643,800
Topsoil Spreading	88,160 SY	$1.43	$126,100
Pollution Control	Lump Sum	$26,660	$26,700
Seeding and Mulching	35.9 Acres	$3,678/acre	$132,000
Removal of principal spillway pipe and riser	Lump Sum	$165,350	$165,400
Road relocation	Lump Sum	$206,900	$206,900
Reservoir reclamation	Lump Sum	$105,000	$105,000
Surveys, Quality Assurance, and other miscellaneous items	Various		$1,331,800
Cost of structure removal*			$6,887,200

* Other significant costs would include mitigation for induced damages, floodproofing of bridges and utilities, loss of recreation, and reduced property values.

Non-Structural - Relocation or Floodproof Structures: Elevating, floodproofing, or relocating the 225 homes, seven businesses (eight business structures), three church buildings, and 33 miscellaneous structures (recreational buildings, social clubs and one public facility) in the breach zone of the dam would cost in excess of $8,000,000 and will not change the need for rehabilitation of the dam. Rehabilitation of the dam to eliminate the potential for a breach will protect these homes, businesses, and roads.

Dry dam: A dry dam is a structure that is built to allow continuous stream flow through the dam during normal conditions while providing flood storage during rainfall events. This alternative was analyzed at the request of the local chapter of Trout Unlimited to investigate the potential to improve aquatic organism passage through the dam. This alternative was eliminated from detailed study due to the exorbitant cost of achieving a suitable fish passage through the embankment. There are several considerations with this alternative:

1. The principal spillway pipe has a diameter of 4 feet and a length of 576 feet. The outlet of the pipe is several feet above the water level in the plunge pool. It would be necessary to reconfigure the outlet to allow passage of fish and other aquatic organisms. Although it would be possible for fish to travel both ways through this pipe, it is not likely that a fish would migrate from downstream to upstream due to the length of the pipe and the velocity of the water flowing through it. Increasing the size of the pipe would necessitate removal and replacement of the dam embankment.
2. There may be problems with sediment accumulation at the pipe inlet. At the present time, the sediment from the watershed is transported down Little River into the lake. The majority of this sediment drops out at the upper end of the lake when the moving water of the river meets the still water of the lake. In a dry dam situation, the sediment would be transported to the inlet of the principal spillway pipe. Although some sediment will pass through, there is the potential for sediment and debris to accumulate at the opening of the pipe. Over time, the sediment could clog the pipe opening. Also, without the installation of trash racks, any debris transported by the river could be trapped at the pipe or in the pipe. Both of these situations would create an operation and maintenance problem. The riser of the principal spillway pipe would have to be removed and a new type of structure would be installed.
3. Initially, there could be a significant amount of sediment released into Little River as the channel cuts through the sediment currently in the lake. If a dry dam is used, there may be a need to create a new, stabilized channel rather than allow the river to develop its own channel.
4. There would be a loss of lake-based recreation. To some degree, this would be offset by an increase in stream-based recreation. With the change to stream-based recreation, there may be a rise in the temperature of the water that is passed through the dam because the relatively shallow stream channel will be completely exposed to sunlight as it passes through the flood pool.
5. Since the sediment storage capacity of the lake would not be filled with water, the flood storage of the lake would be increased by the unused volume of sediment storage.
6. Although there would be additional flood storage with a dry dam, the auxiliary spillway would still need to be rehabilitated to meet the criteria for a high hazard dam. The extra cost of retrofitting the dry dam components would be in addition to the rehabilitation costs.

DESCRIPTION OF ALTERNATIVE PLANS CONSIDERED

Alternatives without Federal Assistance

One of the alternatives that must be included in the plan is the alternative that describes the action that the sponsors will take if no federal funds are expended. Since the Hearthstone Lake dam is a high hazard dam that does not meet current safety and performance standards, the Virginia Division of Dam Safety has issued a conditional certificate of operation for the dam. It is reasonable and prudent to expect that the Virginia Division of Dam Safety will soon issue an Administrative Order requiring the Sponsors to bring the dam up to State standards by rehabilitation of the dam or remove the hazard by removing the storage function of the reservoir. The Sponsors would be totally responsible for the cost of rehabilitation or removal of the dam. NRCS would still have the technical responsibility of approving the Sponsors' solution because the floodwater retarding structure is under an Operation & Maintenance Agreement between the local Sponsors and NRCS until 2016.

At the present time, the potential for an uncontrolled breach and resulting damages is present and will continue until the existing dam safety issues are addressed and resolved.

Without NRCS assistance, the Sponsors would have the following options:

- Hire a consultant, prepare plans to meet the State of Virginia and NRCS standards, and rehabilitate the dam using their own resources.
- Do nothing. In this case, the Virginia Division of Dam Safety may choose to breach the dam and send the Sponsors the bill. This option is likely to be more expensive than if the Sponsors performed the breach. The end results would be the same as those for the next option. This option would not meet the Sponsors' goal of maintaining the existing level of flood protection.
- The Sponsors could remove the flood storage capacity of the dam by breaching the dam using a least cost method. This breach would be a minimum size hole in the dam from the top of the dam to the valley floor, which would eliminate the structure's ability to store water. Downstream flooding conditions would be similar to those that existed prior to the construction of the dam. The sediment would not be stabilized and would migrate downstream. This course of action would minimize the Sponsors' dam safety liability but would not eliminate all liability since it would induce flooding downstream. This option would not meet the Sponsors' goal of maintaining existing levels of flood control.

No Federal Action (Sponsor's Rehabilitation): In the absence of federal assistance, the Sponsors have indicated that they will rehabilitate the dam to meet the required dam safety and design criteria at their own expense using the alternative proposed by NRCS. For the purposes of this evaluation, the Sponsors' Rehabilitation will be the same as the No Federal Action alternative. The estimated total construction cost would be $2,413,000. The total project cost would be $2,949,000.

Alternative with Federal Assistance

Rehabilitation Alternative: Widen auxiliary spillway by 92 feet, raise top of dam by 2.6 feet, enhance surface stability with TRM, retrofit principal spillway riser, and install splitter dike.

Capacity: Widen the auxiliary spillway from 250 feet to 342 feet and raise the top of the dam by 2.6 feet using the material excavated from the auxiliary spillway. The existing front and back slopes of the embankment would be maintained and the top of the dam would be narrowed from 28 feet wide to the minimum allowable top width of 16 feet. In addition, a splitter dike would be added along the centerline of the auxiliary spillway in accordance with NRCS guidance (Appendix C, Figure C3). The typical splitter dike is an earthen structure that is placed parallel to the direction of flow to divide the auxiliary spillway into two narrow sections. The splitter dike would be 5 feet high with 2.5:1 side slopes and a 12-foot top width. An auxiliary spillway greater than 200 feet in width can be vulnerable to the development of concentrated flow channels which would then erode the auxiliary spillway surface. The splitter dike would divide the auxiliary spillway into two sections of 150' in width. Installation of the splitter dike would increase the amount of excavation needed to achieve the required auxiliary spillway capacity. An additional 42 feet of width would be needed for an overall expansion of 92 feet. Approximately 2.4 acres of trees would be removed as part of the auxiliary spillway expansion. Some of the excavated soil material would be used to construct the splitter dike (2,000 CY), extend the existing exit training dike to the valley floor (9,060 CY), and raise the top of the dam (3,300 CY). There would be approximately 32,000 cubic

yards of excess spoil material that would have to be utilized on site or hauled away. The nearest potential site is the original borrow area. About 2.0 acres of trees would be removed prior to soil placement. Trees would be replanted on this area.

Stability: The control section, outlet section, and splitter dike of the auxiliary spillway would be enhanced with Turf Reinforcement Matting (TRM) as discussed above.

Riser: The riser would be retrofitted.

Slope flattening: The excess material would be hauled off-site. The backslope of the dam would remain at 2:1.

Rehabilitation Alternative Variation 1: Widen the auxiliary spillway by 50 feet, raise the top of the dam by 2.6 feet, enhance surface stability with TRM, retrofit the principal spillway riser, and omit splitter dike.

Capacity: Widen the auxiliary spillway from 250 feet to 300 feet and raise the top of the dam by 2.6 feet using the material excavated from the auxiliary spillway. The existing front and back slopes of the embankment would be maintained and the top of the dam would be narrowed from 28 feet wide to the minimum allowable top width of 16 feet. The length of the control section would be increased from 30 feet to 70 feet. The inlet section would have a slope of approximately 2% to the control section. The control section elevation would be maintained at 1843.4. The constructed outlet section would have a slope of 2% for an average of 300 feet. The existing exit training dike would be extended to the valley floor. The exit training dike is used to improve the hydraulic characteristics of auxiliary spillway flows by "training" the water away from the dam embankment. Approximately 2 acres of trees would be removed. See Appendix C, Figure C4.

Stability: The auxiliary spillway would still be constructed of vegetated earth. To enhance the erosion resistance of this surface and minimize the operation and maintenance, the control section and outlet section of the auxiliary spillway will be covered with a surface protection material of Turf Reinforcement Matting (TRM).

The TRM is made of fibrous material that is interwoven into a mat. For Hearthstone, the TRM will be buried under 6 inches of topsoil. The roots of the grass vegetation will interlock with the mat to provide greater erosion resistance (Figure 10).

Riser: The principal spillway riser could be completely removed and replaced for a cost of about $1,242,000. It would still be a two-stage structure with a cold-water release. The only major change would be the footer size and configuration. However, preliminary investigations have determined that it would be feasible to keep the existing riser tower and just retrofit the footer of the structure. The cost of retrofitting the footer would be about $282,000. Retrofitting would include enlarging the footer, replacing the gate and all appurtenances, and surface treating the concrete, as necessary.

Slope flattening: There would be no excess material available for use in flattening the back slope of the dam embankment from 2:1 to 2.5:1.

Figure 10. Installation of TRM.

Rehabilitation Alternative Variation 2: Widen auxiliary spillway by 92 feet, raise top of dam by 2.6 feet, enhance surface stability with TRM, retrofit principal spillway riser, install splitter dike, and flatten the backslope of the dam to 2.5:1.

If Variation 2 is chosen, some or all of the 32,000 cubic yards of spoil material would be available for use in flattening the back slope of the dam embankment. A total volume of 53,000 cubic yards of fill material would be needed to flatten the slope from 2:1 to 2.5:1. A minimum of 21,000 cubic yards would have to be hauled from off-site. Flattening the back slope would necessitate removal and replacement of the road located near the toe of the dam. The additional cost of flattening the back slope would be $630,500 if all the material excavated from the auxiliary spillway is suitable for use (Appendix C, Figure C5).

The Least Cost Alternative: Table E lists the estimated construction cost of the rehabilitation alternative and the two possible variations. The least cost alternative would be Variation 1 (widen the auxiliary spillway by 50 feet, raise the top of the dam by 2.6 feet, enhance the stability of the site with TRM, and retrofit the principal spillway riser). Since two major auxiliary spillway flow events have occurred on this site without causing damage to the auxiliary spillway surface, it may not be necessary to install a splitter dike on this site. However, NRCS guidance recommends the use of a splitter dike for an auxiliary spillway with a width greater than 200 feet. The in-depth analysis needed to omit the splitter dike is beyond the scope of this planning document. If omission of the splitter dike is determined to be feasible during the design phase of the project, there will be a cost savings of $884,000.

Table E. Summary of the Rehabilitation Alternative and Variations and the estimated Construction Costs

Action	**Cost with Riser Replacement**	**Cost with Riser Retrofit**
Rehabilitation Alternative. Widen auxiliary spillway by 92 feet, raise top of dam by 2.6 feet, enhance surface stability with TRM, retrofit principal spillway riser, and install splitter dike.	$3,373,000	$2,413,000
Rehabilitation Variation 1. Widen the auxiliary spillway by 50 feet, raise the top of the dam by 2.6 feet, enhance surface stability with TRM, and retrofit the principal spillway riser.	$2,489,000	$1,529,000
Rehabilitation Variation 2. Widen auxiliary spillway by 92 feet, raise top of dam by 2.6 feet, enhance surface stability with TRM, retrofit principal spillway riser, install splitter dike, and flatten the backslope of the dam to 2.5:1.	$4,003,000	$3,043,000

Preferred Rehabilitation Alternative: The preferred alternative is to widen the auxiliary spillway by 92 feet, raise the top of the dam by 2.6 feet, stabilize the site with TRM, retrofit the principal spillway riser, and install a 42 ft. wide splitter dike.

NATIONAL ECONOMIC DEVELOPMENT (NED) ALTERNATIVE

The Alternative, as described above, is the NED plan. For purposes of the rehabilitation program, the NED plan is defined as the federally assisted alternative with the greatest net economic benefits.

The Sponsors have indicated that, in the absence of federal assistance, they would rehabilitate the dam to meet the required dam safety and design criteria at their own expense using the alternative proposed by NRCS. The Sponsors' Rehabilitation is used as the No Federal Action alternative. The No Federal Action - Sponsor's Rehabilitation alternative would be the same in scope, cost, and effects and the Future with Federal Project alternative. The rehabilitation with federal assistance is the most locally acceptable alternative and best serves the Sponsors in achieving the needs and purpose of this rehabilitation. Therefore, widening the auxiliary spillway, raising top of dam, stabilizing the auxiliary spillway surface with TRM, retrofitting the principal spillway riser, and installing a splitter dike is the NED plan and the preferred alternative. Per the Federal Principles and Guidelines document and NRCS National policy, when the Future Without Federal Project is the same as the Future With Federal Project, the local costs avoided are credited as benefits. This renders the federally assisted alternative as having zero net benefits. Net benefits are zero because, by policy, the total project cost is equal to the claimed benefits and the resulting B/C ratio is 1:1. The results displayed in Table F are presented within a zero-based accounting context to highlight the costs and benefits associated with the recommended alternative alone. Within a

zero-based accounting framework, the "Total Adverse Annualized" value associated with the Future Without Federal Project is displayed as the "Total Beneficial Annualized" in the Future With Federal Project column.

COMPARISON OF ALTERNATIVE PLANS

Table F summarizes the effects of each alternative considered. Refer to the Environmental Consequences section for additional information.

Table F - Summary and Comparison of Alternative Plans

Effects	**Future Without Federal Project** **No Federal Action - Sponsors' Rehabilitation**	**Future With Federal Project** **Rehabilitation with Federal Assistance – Widen auxiliary spillway by 92', raise top of dam by 2.6', enhance surface stability with TRM, retrofit principal spillway riser, and install splitter dike** **Recommended Plan – (NED Plan)**
Sponsor Goals	Continue to provide flood protection; reduce liability.	Continue to provide flood protection; reduce liability.
Structural	Upgrade dam to meet dam safety and design criteria.	Upgrade dam to meet dam safety and design criteria.
Total Project Investment - Hearthstone Lake	$2,949,000	$2,949,000
Total Beneficial Annualized (AAEs*)	---	$103,000
Total Adverse Annualized (AAEs*)	---	$103,000
Net Beneficial	---	$0
Benefit/Cost Ratios	---	1.0 to 1.0
Estimated OM&R**	---	$5,000
Floodplain Management	No change from existing condition.	No change from existing condition.
Streams, Lakes, and Wetlands	Temporary loss of the 12.3 acre lake and temporary impact on 7.86 acres of emergent wetlands during construction.	Temporary loss of the 12.3 acre lake and temporary impact on 7.86 acres of emergent wetlands during construction.
Water quality	No long-term change, minimal short-term effect during construction.	No long-term change, minimal short-term effect during construction.
Water resources	Temporary impact on water quality during construction.	Temporary impact on water quality during construction.
Air Quality	Temporary effect during rehabilitation.	Temporary effect during rehabilitation.
Forest resources	Permanently remove 2.4 acres of trees; remove and replant 2.0 acres of trees in spoil area.	Permanently remove 2.4 acres of trees; remove and replant 2.0 acres of trees in spoil area.
Invasive plant species	Care will be taken during construction to avoid Introduction.	Care will be taken during construction to avoid Introduction.
Riparian areas	No effect.	No effect.
Endangered and Threatened Species	No effect.	No effect.
Fish and wildlife	Aquatic species recovery in 2-4 years.	Aquatic species recovery in 2-4 years.

Effects	Future Without Federal Project No Federal Action - Sponsors' Rehabilitation	Future With Federal Project Rehabilitation with Federal Assistance – Widen auxiliary spillway by 92', raise top of dam by 2.6', enhance surface stability with TRM, retrofit principal spillway riser, and install splitter dike Recommended Plan – (NED Plan)
Migratory birds	Temporary effect during construction.	Temporary effect during construction.
Environmental Justice and Civil Rights	No disparate treatment.	No disparate treatment.
Local and Regional Economy	Temporary positive effect on local and/or regional construction companies. Temporary negative effect due to loss of recreation.	Temporary positive effect on local and/or regional construction companies. Temporary negative effect due to loss of recreation.
Public health and safety	Decrease potential for loss of life from dam breach.	Decrease potential for loss of life from dam breach.
Public recreation	Short-term loss of access during construction.	Short-term loss of access during construction.
Scenic beauty	Short-term effects only.	Short-term effects only.
Social issues	Temporary loss of access to lake.	Temporary loss of access to lake.

* Per 1.7.2 (a) (4) (ii) of the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (P&G), U.S. Water Resources Council, March, 1983, allowing for abbreviated procedures, damage reduction and recreation benefits have not been displayed because they are the same for both alternatives and no net change in benefits occurs when comparing the two candidate plans to each other. The federally assisted alternative is displayed within a zero-based accounting context that credits local costs avoided (Total Adverse Annualized for the Future Without Federal Project scenario) as adverse beneficial effects (Total Beneficial Annualized) consistent with P&G 1.7.2(b)(3). Although the average annual benefits of rehabilitation are $103,000, net benefits are zero because the total project cost is equal to the claimed benefits and the resulting B/C ratio is 1:1. "AAEs" stands for Average Annual Equivalents which are based on a 3.375% discount rate and a 70 year period of analysis (1 year to design, 1 year to install and a 68 year expected useful life).

** "Estimated OM&R" stands for Operation, Maintenance and Replacement Costs.

Note: Regional Economic Development account (RED) concerns were not identified during the scoping process. Therefore, the RED account information is not included

ENVIRONMENTAL CONSEQUENCES

Alternative plans of action can result in a multitude of effects on resources upstream and downstream of Hearthstone Lake. This section describes anticipated effects on resource concerns identified by the Sponsors, the public, and agency personnel in the Scoping meeting and the public meetings. Topics are listed in the same categories as listed in Table F.

There are three plans that were considered and evaluated in detail. However, since the Structural Rehabilitation alternative without the splitter dike required more analysis to determine viability, it was omitted from this section. The effects of the Structural Rehabilitation alternative without the splitter dike will be the same or less than those for the Structural Rehabilitation with a splitter dike because of the smaller footprint in the auxiliary spillway.

1) *No Federal Action (Sponsors' Rehabilitation)* or
2) *Rehabilitation with Federal Assistance (NED Alternative).*

The Sponsors have indicated that they will use the plan developed by NRCS to complete the rehabilitation of the dam in the event that Federal funding is not available. The *No Federal Action (Sponsors' Rehabilitation)* alternative would be the same or involve the same components as the *Rehabilitation with Federal Assistance (NED Alternative).* This alternative maximizes net benefits with a benefit/cost ratio of 1:1, and is the rehabilitation alternative preferred by the Sponsors.

SOILS

There are no identified concerns with Prime and Unique Farmlands and farmland of statewide significance or soil resources.

WATER

There are no identified concerns with regional water resources plans (including coastal resource plans), sewer utilities, sole source aquifers, or Wild and Scenic Rivers.

Floodplain Management

Existing Conditions: Augusta County, Rockingham County, and the Town of Bridgewater currently participate in the National Flood Insurance Program. The existing flood insurance rates for these jurisdictions are based the floodwater reduction effects of the Hearthstone Lake dam.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the Hearthstone Lake dam will be done in accordance with all necessary requirements and restrictions. The existing level of flood protection will be maintained.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Streams, Lakes, and Wetlands

Existing Conditions: The main stream associated with Hearthstone Lake is Little River. Approximately 7.86 acres of fringe wetlands were identified along the shoreline. The 12.3 acres

of the lake are considered to be open water wetlands. No wetlands were identified downstream of the outlet.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the dam will have no permanent adverse effects on Little River or its tributaries. The lake will be drained for 6 to 8 months during rehabilitation. This will result in the temporary loss of 12.3 acres of surface water. The fringe wetlands around the lake will also be temporarily impacted during this time.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Water Quality

Existing Conditions: Little River is listed as impaired for aquatic life and recreation in the 2012 305(b)/303(d) Virginia Water Quality Assessment Report.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the dam will not alter the present water quality in the watershed. With the required erosion and sediment control measures, there should be minimal temporary impacts on water quality associated with construction. There may be a temporary reduction in dissolved oxygen in Little River downstream of the dam while the water is drained. No long-term impacts on water quality from rehabilitation activities are anticipated.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Water Resources

Existing Conditions: The primary purpose of the lake is to provide flood protection. However, it has become an important part of the community because of the recreation value that it provides.

No Federal Action (Sponsors' Rehabilitation): There may be a temporary impact on downstream water quality and temperature when the water is released prior to construction.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

AIR

Air Quality

Existing Conditions: Air quality in the area is satisfactory. Augusta County is not within a non-attainment area for ozone or particulate matter-2.5 ($PM_{2.5}$) according to the 2010 Virginia Ambient Air Monitoring Data Report.

No Federal Action (Sponsors' Rehabilitation): During the rehabilitation of the dam, particulate matter (dust) from construction activities will increase. Air pollution abatement actions will minimize any potential temporary dust problems during construction, and the proposed work is not expected to violate any federal, state, or local air quality standards.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

PLANTS

There are no identified concerns with Endangered and Threatened Plant Species or Natural Areas.

Forest Resources

Existing Conditions: Hearthstone Lake is located within the George Washington and Jefferson National Forest. Approximately 99.2% of the watershed above the dam is forested. The Forest boundaries extend approximately 4.35 miles below the dam. There is a proposed Wilderness Area in the watershed. The U.S. Forest Service does not own the subsurface mineral rights in the watershed. Although there currently is no mining activity, there is some potential for mining in the future. The removal of trees needed to perform this work could cause an increase in the amount of sediment transported into the reservoir. This would decrease the expected life of the structure.

No Federal Action (Sponsors' Rehabilitation): During the rehabilitation of the dam, there will 2.4 acres of trees removed from the outlet of the auxiliary spillway and another 2.0 acres will be removed from the borrow area. The borrow area will be replanted with trees of the appropriate species.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Invasive Plant Species

Existing Conditions: At the present time, there are no known invasive species on the site.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the Hearthstone Lake dam would not change the existing conditions for invasive species. Care will be taken during construction to avoid the introduction of invasive species and comply with Executive Order 13112.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Riparian Areas

Existing Conditions: There are riparian areas around the lake and along Little River.

No Federal Action (Sponsors' Rehabilitation): There will be no long-term or short-term change to the riparian areas.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

ANIMALS

There are no identified concerns with coral reefs, ecologically critical areas, essential fish habitat, or invasive animal species.

Endangered and Threatened Species

Existing Conditions: There is habitat in the watershed for the Indiana bat but there have been no confirmed sightings.

No Federal Action (Sponsors' Rehabilitation): There was no indication of the presence of the Indiana bat in the watershed. Therefore, rehabilitation of the dam will have no effect on the Indiana bat population.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Fish and Wildlife

Existing Conditions: The Virginia Department of Game and Inland Fisheries stock Hearthstone Lake with pike and rainbow trout

No Federal Action (Sponsors' Rehabilitation): Although the lake would be drained during rehabilitation, the fisheries are expected to recover within two to four years after restocking.

Rehabilitation with Federal Assistance – (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Migratory Birds

Existing Conditions: The lake could potentially be utilized by several species of migratory birds for feeding, nesting, or resting.

No Federal Action (Sponsors' Rehabilitation): While the 12.3 acre lake is drained, it will be temporarily unavailable for migratory birds. There are similarly sized bodies of water throughout the region which could be used.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

HUMAN

There are no identified concerns with cultural resources, land use, parklands, or scientific resources.

Environmental Justice and Civil Rights

Existing Conditions: There is an estimated population of 630 in the breach zone below the dam. The presence or absence of environmental justice groups within the watershed is not known.

No Federal Action (Sponsors' Rehabilitation): Rehabilitation of the dam will have positive economic and social effects across all residents within the floodplain and above the dam. There will be no disparate treatment. Since vehicle operators also are significant beneficiaries of the proposed rehabilitation, it is reasonable to conclude that protection of the roads and bridges will benefit all racial, ethnic, and socio-economic groups within the watershed and below the dam. Avoiding a dam breach will directly benefit all local residents and taxpayers in general within Augusta County and the Commonwealth of Virginia.

There are no known disparate impacts from the rehabilitation project. It was explained to local residents that rehabilitation of the dam would not enhance their downstream flood protection, but simply maintain the designed level of flood protection while reducing the risk to life and property that might occur from a dam breach.

Approximately 630 people would benefit directly from the rehabilitation of the dam. There are indirect benefits for the estimated 1,800 more people who use the area around the lake for recreation during the summer, spring and fall.

There would also be downstream benefits to the occupants of about 700 vehicles/day along Stokesville Road and Towers Road that would be affected by a breach event. This is primarily those people affected by impacts to the roads and bridges and includes others who would lose access to emergency services or would be cut off from their residences or jobs.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Local and Regional Economy

Existing Conditions: The recreation use of the lake, the seven local businesses, the downstream farming, and the roads used for commuting to work sites contribute significantly to the local economy.

No Federal Action (Sponsors' Rehabilitation): There would be a temporary positive effect on the local economy during the construction period. This may be offset by the temporary loss of revenue associated with recreation.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Public Health and Safety

Existing Conditions: The existing vegetated earth auxiliary spillway has the integrity necessary to withstand the Probable Maximum Precipitation event but does not have the capacity. It is projected that the dam would overtop during a 6-hour precipitation event of approximately 28 inches or during a 24-hour precipitation event of about 36 inches. Overtopping the dam could cause the dam to erode and collapse. Approximately 630 people are at risk for loss of life. There are 225 homes and seven businesses in the breach zone of this dam. The Girl Scout Camp has 30 buildings that would be at risk. Four bridges and 16 culverts could also be impacted. There are seven state roads and 16 private roads in the breach zone.

No Federal Action (Sponsors' Rehabilitation): Under this alternative, the dam would be structurally rehabilitated using current design and safety criteria in order to provide continued flood protection for 75 years after the rehabilitation period is complete. The downstream flooding levels would be the same as they are presently. The threat to loss of life from failure of the dam would be greatly reduced. Access to the site will be restricted during construction.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Public Recreation

Existing Condition: Hearthstone Lake provides opportunities for lake-based activities such as canoeing, walking, bird watching and fishing.

No Federal Action (Sponsors' Rehabilitation): There are no anticipated permanent changes to the existing recreational opportunities as a result of the planned rehabilitation activities. During the 6 to 8 month construction period, the lake will be drained and access to the lake will be limited. There are a number of other lakes in the area that could be used for fishing.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Scenic Beauty

Existing Condition: At the present time, the dam embankment, the auxiliary spillway and training dikes are in grass. The area surrounding the rest of Hearthstone Lake is forested.

No Federal Action (Sponsors' Rehabilitation): When the rehabilitation of the auxiliary spillway is complete, the entire length of the auxiliary spillway will be in grass. There will be temporary impacts to the scenic beauty of the area while the lake is drained and construction is underway.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

Social Issues

Existing Condition: Hearthstone Lake has provided value to the community since 1966 by providing flood protection, recreation, and scenic beauty. At the public meeting, the main concern expressed by the local citizens was the need to maintain the flood protection provided by the structure. However, there was also some concern expressed about the use of government funds to provide flood protection.

No Federal Action (Sponsors' Rehabilitation): When rehabilitation of the dam is complete, the dam will provide flood protection for an additional 68 years. Once flood control benefits have been provided, the Sponsors could face significant liability issues if flood damages are induced.

Rehabilitation with Federal Assistance (NED Alternative): Same as the No Federal Action (Sponsors' Rehabilitation).

CUMULATIVE EFFECTS

NRCS has constructed three flood control dams in this watershed; Todd Lake, Hearthstone Lake, and Elkhorn Lake. Todd Lake and Hearthstone Lake are currently operating under conditional certificates due to a need for rehabilitation. The No Federal Action alternative for Hearthstone Lake calls for the Sponsors to rehabilitate the dam. The proposed rehabilitation alternative would have the same effect on the environment as the No Federal Action alternative. The cumulative effects of the other projects on the principal resources of concern, along with the social and economic effects, are to maintain the existing social, economic, and environmental conditions of the community. The cumulative effects of rehabilitating Hearthstone Lake would also maintain the existing social, economic and environmental conditions of the community. In both the recommended plan and the rehabilitation by the local Sponsors, all of the existing dams in the watershed stay in place, essentially the same level of flood protection is provided, and the existing emergency action plan remains in force.

RISK AND UNCERTAINTY

Assessments, considerations, and calculations in this plan are based on a 70-year period of analysis. Associated monetary flooding impacts on downstream houses and businesses were based on the National Flood Insurance Program's Actuarial Rate Review. National averages were used to identify the value of potential damages. Actual damages occurring from each storm event could realistically be higher or lower, depending on soil moisture conditions at the time of a given event, associated debris flows, future development, and other factors such as changes in precipitation from various storm events. Although potential climatic changes are not expected to alter calculation of the PMP events, they could increase the occurrence of low frequency, high intensity storm events and associated flood damages.

An easement was procured to the crest of the auxiliary spillway prior to the original construction as part of the Special Use Permit issued by the U.S. Forest Service. The Special Use Permit will be re-issued prior to rehabilitation. This meets NRCS policy.

No long-term changes to water quality are anticipated due to this project.

The sediment rate projected for the life of the Future with Federal Assistance (Preferred Alternative) is based on the past rate of sediment accumulation in the watershed. Very large storm events or destruction of forest through wildfires could cause an increased rate of deposition. At the present time, there are no known plans for land use changes in this watershed that would affect the rate of sediment deposition in the reservoir. However, since the mineral rights are not owned by the Forest Service, there is the potential for some mining to occur.

The objective of this project is to meet applicable NRCS and Virginia safety and performance standards for a high hazard dams. From a financing and administrative standpoint, the Sponsors have committed to NRCS that they are able to fund the required 35% of the total project costs to complete installation of the selected alternative and can perform the required maintenance on the upgraded structure for 68 years after construction.

Statistically, there is a less than 0.2% chance in any given year that the auxiliary spillway would flow during the anticipated life of the rehabilitated structure. However, it is possible for several events to occur during this time period. If an auxiliary flow event occurs that removes the topsoil and the TRM, the estimated repair cost would be $30,000 and would take approximately one month. This would include 1,000 square yards of TRM, topsoil and seed. The estimates do not include any costs for offsite damages incurred during this event. Routine maintenance is not included in these amounts. This project plan assumes that such an event will likely occur once within the expected useful life. However, based on past experience, no auxiliary spillway damage is anticipated.

CONSULTATION AND PUBLIC PARTICIPATION

The sponsoring organizations are the Headwaters SWCD and the Augusta County Board of Supervisors. The Headwaters Soil and Water Conservation District has been responsible for the operation and maintenance of the Hearthstone Lake Dam since 1993. Interest for rehabilitating the dam began in October 2011 with the issuance of a Conditional Certificate by the Virginia Division of Dam Safety. The certificate was issued because of problems identified with the auxiliary spillway. In 2012, the Division of Dam Safety contracted with a private engineering firm to conduct a detailed analysis of the auxiliary spillway. The firm identified potential problems with the capacity of the auxiliary spillway. NRCS received an application for federal assistance for the Hearthstone Lake Dam rehabilitation in January 2012.

Local, state and federal support for the rehabilitation of the Hearthstone Lake Dam has been strong. Input and involvement of the public has been solicited throughout the planning of the project. At the initiation of the planning process, many meetings were held with representatives of the Headwaters Soil and Water Conservation District and Augusta County to ascertain their interest and concerns regarding the dam. The Sponsors have worked closely with the local landowners and residents to provide information on the planning activities and to solicit their input on the pertinent issues to be considered during planning. The Sponsors worked to provide all residents, including minorities, with information on the planning effort and intended works of improvement.

The U.S. Forest Service consulted with the U.S. Fish and Wildlife Service and with Virginia Department of Historic Resources during this process.

A scoping meeting was held on April 3, 2014, at the Augusta County Government Center in Verona, Virginia, to identify issues of economic, environmental, cultural, and social concerns in the watershed. Input was provided by local, regional, state and federal agencies at the meeting or through letters and emails to NRCS. There were 21 people in attendance.

The first public meeting for Hearthstone Lake was held at the Sangerville-Towers Ruritan Hall, in Mount Solon, Virginia, on April 3, 2014. Local, state and federal perspectives on the rehabilitation needs of the Hearthstone Lake Dam were provided. The attending members of public were informed of the dam rehabilitation program and potential alternative solutions to bring the dam into compliance with current dam safety and design criteria. Meeting participants provided input on their issues and concerns to be considered during the planning process. A fact sheet was developed and distributed which addressed frequently asked questions regarding rehabilitation of the dam. There were 48 people in attendance. The audience included elected officials, representatives from county and federal agencies, and watershed residents.

A second public meeting was held on January 22, 2015 at the Sangerville-Towers Ruritan Hall in Mount Solon, Virginia. Information provided to meeting attendees included a summary of the current situation of the dam, planning efforts to date, the various alternatives considered during planning, and a detailed explanation of the recommended alternative for dam rehabilitation. Attendees understood the need for the rehabilitation. There were 35 people in attendance. The audience included elected officials, representatives from county and federal agencies, and watershed residents.

A Draft Plan was distributed for interagency and public review on May 5, 2015. Copies of the document were placed in local libraries and news articles were placed in local newspapers to solicit comments from the public during the comment period. After a 30-day review period, comments received on the draft were incorporated into the Final Plan. Letters of comment received on the draft plan and NRCS responses to the comments are included in Appendix A.

PREFERRED ALTERNATIVE

RATIONALE FOR PLAN SELECTION

The recommended plan is to rehabilitate the dam to meet current NRCS and the Commonwealth of Virginia safety and performance standards for high hazard dams. The recommended plan meets the identified purposes and needs for the project and significantly reduces the potential risk to human life. The project Sponsors, local residents, and state and local government agencies all prefer the Recommended Plan because it:

- Minimizes the threat to loss of life to approximately 630 people that live in the 225 homes within the breach inundation zone.
- Provides protection for more than 740 vehicles per day that utilize Stokesville Road (520), Towers Road (190) and Reeves Road (30 vehicles). There are no traffic numbers for Tillman Road but there are a number of residences located along the road.
- Provides onsite benefits to approximately 1,800 recreational users and offsite benefits to an additional 1,000 people (vehicle occupants).
- Minimizes the threat of loss of emergency service for a significant number of residences, several businesses, and three churches.
- Provides downstream flood protection for the people living in the area, as well as those working, recreating, or traversing within the downstream floodplains, for an additional 68 years.
- Eliminates the liability associated with continuing to operate a non-compliant dam.
- Maintains existing stream habitat downstream of the dam.
- Retains the existing aquatic and terrestrial habitat around the lake.
- Leverages federal resources to install the planned works of improvement.

The selected alternative meets the Sponsors' objectives of bringing this dam into compliance with current dam design and safety criteria, maintaining the current 100-year floodplain, and addressing resource concerns identified by the public. The selected plan is the NED Alternative. The plan reasonably meets the following four criteria: completeness, effectiveness, efficiency, and acceptability. NRCS and the Sponsors are in agreement on the recommended plan.

SUMMARY AND PURPOSE

The recommended plan of action for the dam is outlined below:

- Widen the auxiliary spillway to an effective width of 300 feet. The total width, with the splitter dike, will be 342 feet. Move the control section upstream and lengthen it to 70 feet.
- Install a 42-foot wide earthen splitter dike along the centerline of the auxiliary spillway. The splitter dike will be 42 feet wide at the base, 12 feet wide at the top, and 5 feet high.

- Enhance the stability of the control section and constructed outlet section with TRM and cover the TRM with topsoil and vegetation.
- Augment the earthen training dike that extends from the top of the dam to the top of the hillslope to protect the dam embankment and to contain the auxiliary spillway flows.
- Raise the dam embankment by 2.6 feet with earthfill.
- Retrofit the footer of the principal spillway riser.

After the implementation of these planned works of improvement, Hearthstone Lake will meet all current NRCS and State of Virginia dam safety and performance standards.

Financial assistance from NRCS for rehabilitation of this dam is contingent on receipt of funding from Congress.

Detailed structural data for the proposed rehabilitated dam can be found in Table 3.

EASEMENTS AND LANDRIGHTS

Land rights for the structure currently exist for the floodpool at the elevation of the crest of the auxiliary spillway based on the original easement for the project. The elevation of the crest of the auxiliary spillway will not change for implementation of the recommended alternative. The structure is located in the National Forest and the planned future land does not include any development. Additional landrights are not required because there will be no development in the area between the elevation of the crest of the auxiliary spillway and the top of the dam.

MITIGATION

No compensatory mitigation has been identified. During construction, site mitigation measures will include erosion and sediment control, seeding of denuded areas, dust control, and other practices identified during the design process. The borrow area, if needed, will be replanted to trees and the lake will be restocked by Virginia DGIF.

PERMITS AND COMPLIANCE

The Sponsors are responsible for obtaining the Special Use Permit associated with the rehabilitation project. Prior to construction, the Sponsors will be responsible for obtaining an alteration permit from the Virginia Soil and Water Conservation Board, and, as needed, a 404 permit from the Army Corps of Engineers, subaqueous lands permits from the Virginia Marine Resources Commission, and any other required permits. During construction, the successful contractor is required to develop a Stormwater Pollution Prevention Plan which includes applicable erosion and sediment control measures.

If cultural resources are discovered during installation, work will cease and applicable U.S. Forest Service procedures will be implemented.

The Sponsors will be responsible for obtaining the certification of compliance from the Virginia Division of Dam Safety upon completion of the project.

COSTS

As indicated in Table 2, the total installation cost of the recommended plan is $2,949,000. Of this amount, PL-83-566 funds will bear $2,102,000 and nonfederal funds will bear $847,000. Table 2 shows details of the costs and cost-share amounts by category. Total annualized costs are shown in Table 4 along with the estimated costs for operation and maintenance. Table 5 displays the average annual flood damage reduction benefits by flood damage categories, and Table 6 displays a comparison of annual costs and benefits. A 2014 price base was used and amortized at 3.375 percent interest for the 70 year period of analysis (including a design and installation period of two years and an expected useful life of 68 years).

The cost projections for the proposed rehabilitation measures are estimated costs only for the purpose of planning. The fact that these costs are included in this plan does not infer that they are final costs. Detailed structural designs and construction cost estimates will be prepared prior to contracting for the work to be performed. Final construction costs will be those costs actually incurred by the contractor performing the work, including the cost of any necessary contract modifications.

INSTALLATION AND FINANCING

The project is planned for installation in one construction season. During construction, equipment will not be allowed to operate when conditions are such that soil erosion and water, air, and noise pollution cannot be satisfactorily controlled.

The NRCS will provide assistance to the Sponsors with the Hearthstone Lake Dam rehabilitation project. NRCS will be responsible for the following:

- Execute a project agreement with the Sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
- Execute a Memorandum of Understanding with the Sponsors to provide a framework within which cost-share funds are accredited.
- Execute an updated Operation and Maintenance Agreement with the Sponsors that extends the O&M responsibilities for another 68 years following construction. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Provide financial assistance equal to 65% of total eligible project costs, not to exceed 100% of actual construction costs.
- Verify that a current Emergency Action Plan is developed before construction is initiated.
- Provide consultative engineering support, technical assistance, and approval during the design and construction of the project.
- Certify completion of all installed measures.

The Sponsors will be responsible for the following:

- Secure all needed environmental permits, easements, and rights for installation, operation and maintenance of the rehabilitated structure. This includes the Special Use Permit issued by the U.S. Forest Service.
- Prepare an updated Emergency Action Plan for the dam prior to the initiation of construction.
- Execute an updated Operation and Maintenance Agreement with NRCS for the dam. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Execute a Memorandum of Understanding with NRCS to provide a framework within which cost-share funds are accredited.
- Execute a project agreement with NRCS before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
- Provide nonfederal funds for cost-sharing of the project at a rate equal to, or greater than, 35% of the total eligible project costs.
- Acquire a regular Operation and Maintenance certificate from the Virginia Division of Dam Safety upon completion of the planned measures.
- Participate in and comply with applicable Federal floodplain management and flood insurance programs.
- Enforce all associated easements and rights-of-way for the safe operation of the dam.

OPERATION, MAINTENANCE, AND REPLACEMENT

Measures installed as part of this plan, and previously installed measures, will be operated and maintained by the Headwaters SWCD with technical assistance from federal, state, and local agencies in accordance with their delegated authority. A new Operation and Maintenance agreement will be developed for Hearthstone Lake and will be executed prior to signing a project agreement for the construction of the project. The term of the new O&M agreement will be for 68 years following the completion of rehabilitation. The agreement will specify responsibilities of the Sponsors and include detailed provisions for retention, use, and disposal of property acquired or improved with PL 83-566 cost sharing. Provisions will be made for free access of district, state, and federal representatives to inspect all structural measures and their appurtenances at any time.

Table 1 - Estimated Installation Cost
Upper North River Dam No. 77, Virginia
(Dollars)[1]

Installation Cost Items	Estimated Costs		
Structural measures to rehabilitate floodwater retarding dam:	PL-83-566 Funds[2]	Other Funds	Total
Rehab. Upper North River Dam No. 77:	$2,102,000	$847,000	$2,949,000
Total Project:	$2,102,000	$847,000	$2,949,000

Price base: December, 2014 Prepared: December 2014

Table 2 - Estimated Cost Distribution – Structural Measures
Upper North River Dam No. 77, Virginia
(Dollars)

	Installation Cost: PL-83-566 Funds[3]				Installation Cost: Other Funds[4]						
Installation Cost Items	Construction Costs	Engi-neering Technical Assistance Costs	Project Admin-istration Costs	Total PL-83-566 Cost	Construction Costs	Engineering Costs	Real Property Land Rights	Permits	Project Admin-istration Costs	Total Other Funds	Total Project Cost[5]
Rehab. No. 77:	$1,577,000	$475,000	$50,000	$2,102,000	$836,000	$2,000	$0	$3,000	$6,000	$847,000	$2,949,000
Totals:	$1,577,000	$475,000	$50,000	$2,102,000	$836,000	$2,000	$0	$3,000	$6,000	$847,000	$2,949,000

Price base: December 2014. Prepared: December 2014

[1] All tables have a price base of 2014.
[2] Paid by the USDA/NRCS – the Federal agency responsible for assisting in installation of improvements.
[3] 65% of total eligible project cost (The actual federal cost/share excludes technical assistance and permit costs and cannot exceed 100% of the estimated construction cost).
[4] 35% of total project cost. Per NRCS policy, $5,000 in local sponsor planning costs were excluded from Tables 1 and 2. These sponsor costs are included in the calculation of cost/share as shown in the watershed agreement.
[5] Note: As per the NRCS National Watershed Manual, Part 508.44, the actual federal cost/share amount will be calculated based on a total eligible project cost that excludes federal technical assistance costs, water, mineral and other resource rights, and all federal, state and local permits. However, for the purposes of planning, all of these costs are included in the benefit/cost analysis and are displayed as part of the public record of this analysis.

Table 3 – Structural Data for Rehabilitated Dam

Upper North River Dam No. 77, Virginia

ITEM	UNIT	AMOUNT
Hazard Class of Structure	-	High
Seismic Zone	-	2
Total Drainage Area	Sq. Mi.	15.86
Time of Concentration	Hours	2.80
Antecedent Moisture Condition II Runoff Curve Number	-	58
Elevation, Top of Dam[1]	Feet, MSL	1858.7
Elevation, Auxiliary Spillway Crest[1]	Feet, MSL	1843.4
Elevation, Principal Spillway Orifice Crest[1]	Feet, MSL	1779.2
Auxiliary Spillway Type	-	Vegetated earth
Auxiliary Spillway Bottom Width	Feet	342
Auxiliary Spillway Exit Slope	%	2.02
Maximum Height of Dam	Feet	109.6
Volume of Fill (Rehabilitation)	Cu. Yd.	3,300
Total Capacity	Ac.-Ft.	3,018
Sediment Submerged[2]	Ac.-Ft	134
Sediment Aerated[2]	Ac.-Ft	116
Floodwater Retarding Pool	Ac.-Ft.	2,768
Surface Area		
Sediment Pool	Acres	12.3
Floodwater Retarding Pool	Acres	81.6
Principal Spillway Design		
Rainfall Volume (1 day)	Inches	6.67
Rainfall Volume (10 day)	Inches	9.61
Runoff Volume (10 day)	Inches	1.9
Capacity at Crest of Auxiliary Spillway	CFS	460.9
Conduit Size	Inches	48
Conduit Type	-	Concrete
Frequency of Operation, Auxiliary Spillway	Annual % chance	0.2[3]
Auxiliary Spillway Hydrograph		
Rainfall Volume	Inches	10.5
Runoff Volume	Inches	4.99
Storm Duration	Hours	6
Velocity of flow (V_e)	Ft/s	9.2
Maximum Surface Elevation	Feet, MSL	1847.7
Freeboard Hydrograph (6-hr PMP)[4]		
Rainfall Volume	Inches	28
Runoff Volume	Inches	20.86
Storm Duration	Hours	6
Maximum Surface Elevation	Feet, MSL	1858.7
Capacity Equivalents		
Submerged Sediment	Watershed Inches	0.16
Aerated Sediment	Watershed Inches	0.14
Floodwater capacity	Watershed Inches	3.28

[1] Datum: NAVD88. Prepared: December 2014

[2] Based on 2012 sediment survey.

[3] The auxiliary spillway has a statistical frequency of operation of once in 500 years.

[4] Both the 6-hour and 24-hour duration storms were evaluated. The 6-hour storm duration was the critical duration for the freeboard hydrograph.

Table 4 - Average Annual National Economic Development (NED) Costs
Upper North River Dam No. 77, Virginia
(Dollars)

	Average Annual Equivalent Cost	Annual Operation and Maintenance Costs	Total Average Annual Equivalent Cost
Rehabilitation of Upper North River Dam No. 77	$98,000	$5,000	$100,000
Totals:	$98,000	$5,000	$100,000

Price base: December 2014 Prepared: December 2014

Note: The average annual equivalents are based on a 3.375% discount rate and a 70 year period of analysis (2 years for project design/installation and 68 years of expected useful life).

Table 5 - Estimated Average Annual Flood Damage Reduction Benefits
Upper North River Dam No. 77, Virginia
(Dollars)

Flood Damage Category	Estimated Average Annual Equivalent Damages		Damage Reduction Benefits
	Without Federal Project	With Federal Project	Average Annual Equivalents
Agricultural damages	$7,500	$7,500	$0
Major Improvements (structure and content damages)	$30,000	$30,000	$0
Minor improvements	$5,900	$5,900	$0
Infrastructure damages	$40,900	$40,900	$0
George Washington National Forest facilities	$2,900	$2,900	$0
Other (miscellaneous damages)	$2,400	$2,400	$0
Totals (rounded):	$89,600	$89,600	$0

Price base: December 2014 Prepared: December 2014

Note: Damage reduction benefits resulting from the recommended plan equal zero as compared to the no federal action alternative because they are the same in scope, cost and effects, and therefore yield equivalent benefits.

Table 6 - Comparison of National Economic Development (NED) Benefits and Costs
Upper North River Dam No. 77, Virginia
(Dollars)

Evaluation Unit	Average Annual Equivalent Benefits: Damage Reduction Benefits	Average Annual Equivalent Benefits: Total Average Annual Equivalent Benefits[1]	Costs: Average Annual Equivalent Costs	Net Change: Net Average Annual Equivalent Benefits	Benefit/ Cost Ratios
Upper North River Dam No. 77	$0	$100,000	$100,000	$0	1.0 to 1.0
Totals:	$0	$100,000	$100,000	$0	1.0 to 1.0

Price base: December, 2014 Prepared: Dec. 2014

Note: The average annual equivalents are based on a 3.375% discount rate and a 70 year period of analysis (2 year for project design/installation and 68 years of expected minimum useful life).

[1] The costs and benefits of the Future With Project Plan are the same as those for the Future Without Project Plan. To maintain consistency with the display in Table 4, the costs associated with the No Action Alternative are tracked as a benefit of the Preferred Alternative.

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REPORT PREPARERS

The Upper North River Watershed Supplemental Plan and Environmental Assessment was prepared primarily by the Virginia NRCS Planning Team located in Richmond, Virginia; Verona, Virginia; and Morgantown, West Virginia. The document was reviewed and concurred in by state staff specialists having responsibility for engineering, resource conservation, soils, agronomy, biology, economics, geology, and contract administration. The in-house review was followed by a review by the NRCS National Water Management Center and project sponsors, and then an interagency and public review.

Name	**Present Title and Years in Current Position**	**Education**	**Previous Experience**	**Other**
Rebecca M. Evans	Civil Engineering Technician - 6	B.S. Natural Resources Recreation	Conservation Specialist – 2 yrs.	
David L. Faulkner	Natural Resource Economist - 25	M.S. Ag. Economics B.S. Ag. Education	Ag. Economist (SCS) - 2.5 yrs. Ag. Economist (U.S.A.I.D.) - 4.5 yrs. Ag. Teacher (Peace Corps) – 2 yrs.	
Fred M. Garst	GIS Specialist - 21	B.S. Geology	GIS/Soil Scientist - 7 yrs. Soil Cons. Tech. - 7 yrs. Geologist (Private) – 4 yrs.	
Jeffray Jones	State Biologist - 3	B.S. Natural Resources Management	Ecologist - 22 yrs.	
Alica J. Ketchem	Environmental Engineer - 21	B.S. Civil Engineering M.S. Agricultural Eng.	Civil Engineer – 10 yrs.	P.E.
Amanda L. Lynch	Environmental Specialist - 1	B.S. Biology M.S. Natural Resources Management	Natural Resource Specialist – 5 yrs.	
Mathew J. Lyons	State Conservation Engineer-13	B.S. Civil Engineering	Civil Engineer – 12 yrs.	P.E.
Jeffrey D. McClure	Geologist - 10	B.A. Geology B.A. Biology B.S. Geology	NRCS Geologist – total 11.5 yrs. Geologist (WV Dept. of Env. Prot.) - 11 yrs. Geologist (Private) – 8.5 yrs.	CPG in KY, VA, DE and PA
Kelly Ramsey	Hydraulic Engineer - 9	B.S. Biological Systems Engineering	Civil Engineer – 12 yrs.	P.E.
Gerald W. Wright	Project Engineer - 8	B.S. Civil Engineering	Civil Engineer – 20 yrs.	P.E., PLS

The table identifies and lists the experience and qualifications of those individuals who were directly responsible for providing significant input to the preparation of the Supplemental Plan/EA. Appreciation is extended to many other individuals, agencies and organizations for their input, assistance and consultation, without which this document would not have been possible.

Special acknowledgment goes to John Kaylor, Headwaters Soil and Water Conservation District, who spent many hours in the Upper North River Watershed surveying, collecting data, meeting with landowners, and attending public meetings, and providing technical support.

DISTRIBUTION LIST

Comments were requested on the Draft Supplemental Plan – EA from the following agencies and organizations.

	Response Received on Draft Supplemental Plan/EA
Federal Agencies	
Environmental Protection Agency Region III, Philadelphia	
U.S. Army Corps of Engineers Norfolk District	
U.S. Department of the Interior Fish and Wildlife Service Gloucester, Virginia Office	
Federal Emergency Management Agency Philadelphia	
U.S. Department of Agriculture Forest Service Farm Service Agency Rural Development	
Virginia State Agencies	
Virginia Department of Environmental Quality Office of Environmental Impact Review (State Clearinghouse)	
Virginia Department of Emergency Management	
Virginia Department of Conservation and Recreation Division of Soil and Water Conservation Division of Dam Safety and Floodplain Management Division of Natural Heritage Division of Planning and Recreation Resources	
Virginia State Agencies	
Virginia Soil and Water Conservation Board (Governor's Designated Agency)	
Virginia Department of Game and Inland Fisheries	

	Response Received on Draft Supplemental Plan/EA
Virginia Marine Resources Commission	
Virginia Department of Historic Resources	
Virginia Department of Transportation	
Other	
Virginia Association of Soil and Water Conservation Districts	
Headwaters Soil and Water Conservation District	
Shenandoah Valley Soil and Water Conservation District	
Augusta County	
Department of Community Development	
Board of Supervisors	
Rockingham County	
Board of Supervisors	
Town of Bridgewater	
Central Shenandoah Planning District Commission	

INDEX OF KEY WORDS AND PHRASES

APPENDIX A

COMMENT AND RESPONSES

(To be included in final environmental impact statement or assessment)

APPENDIX B

PROJECT MAPS

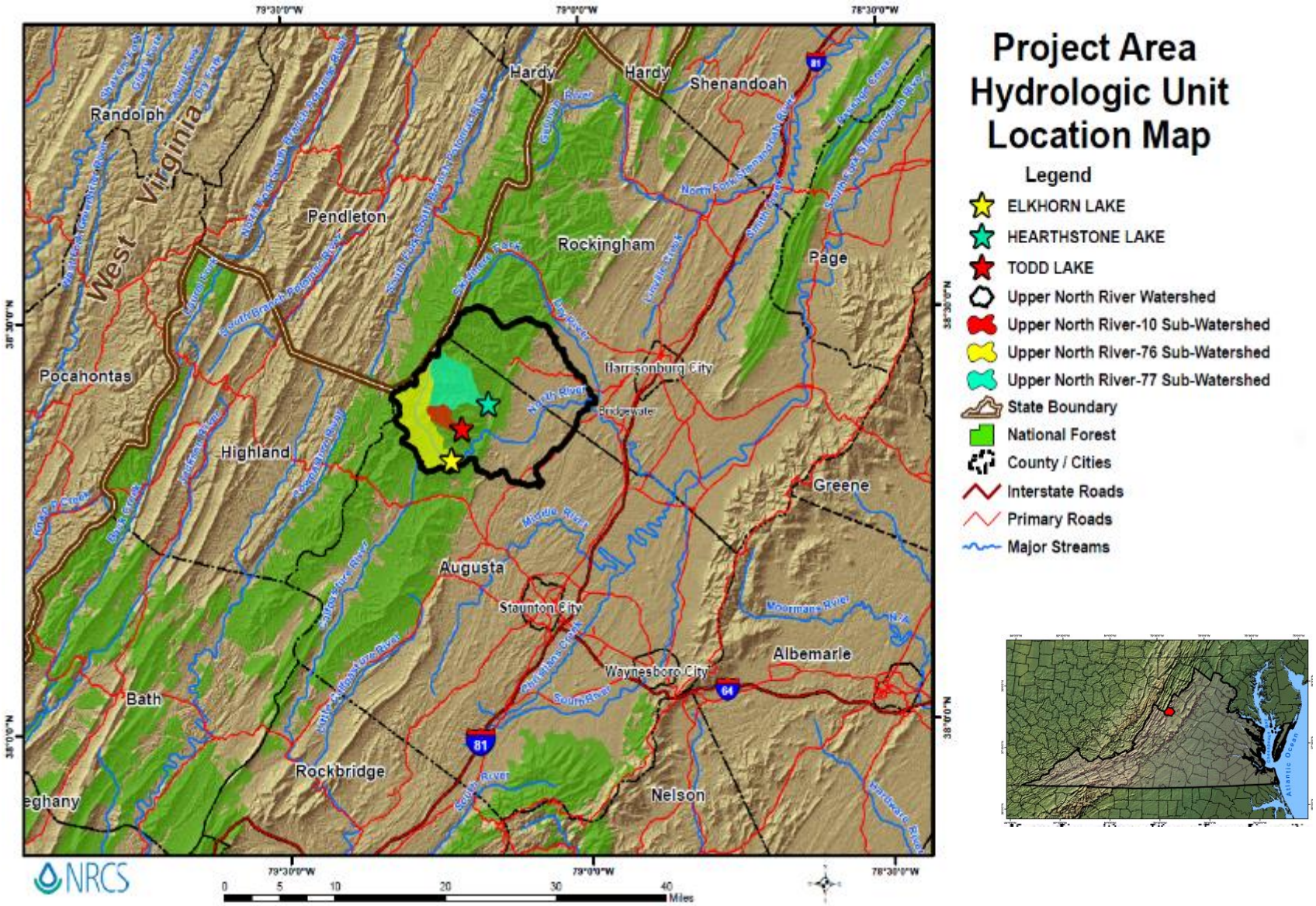

Figure B1. Location map.

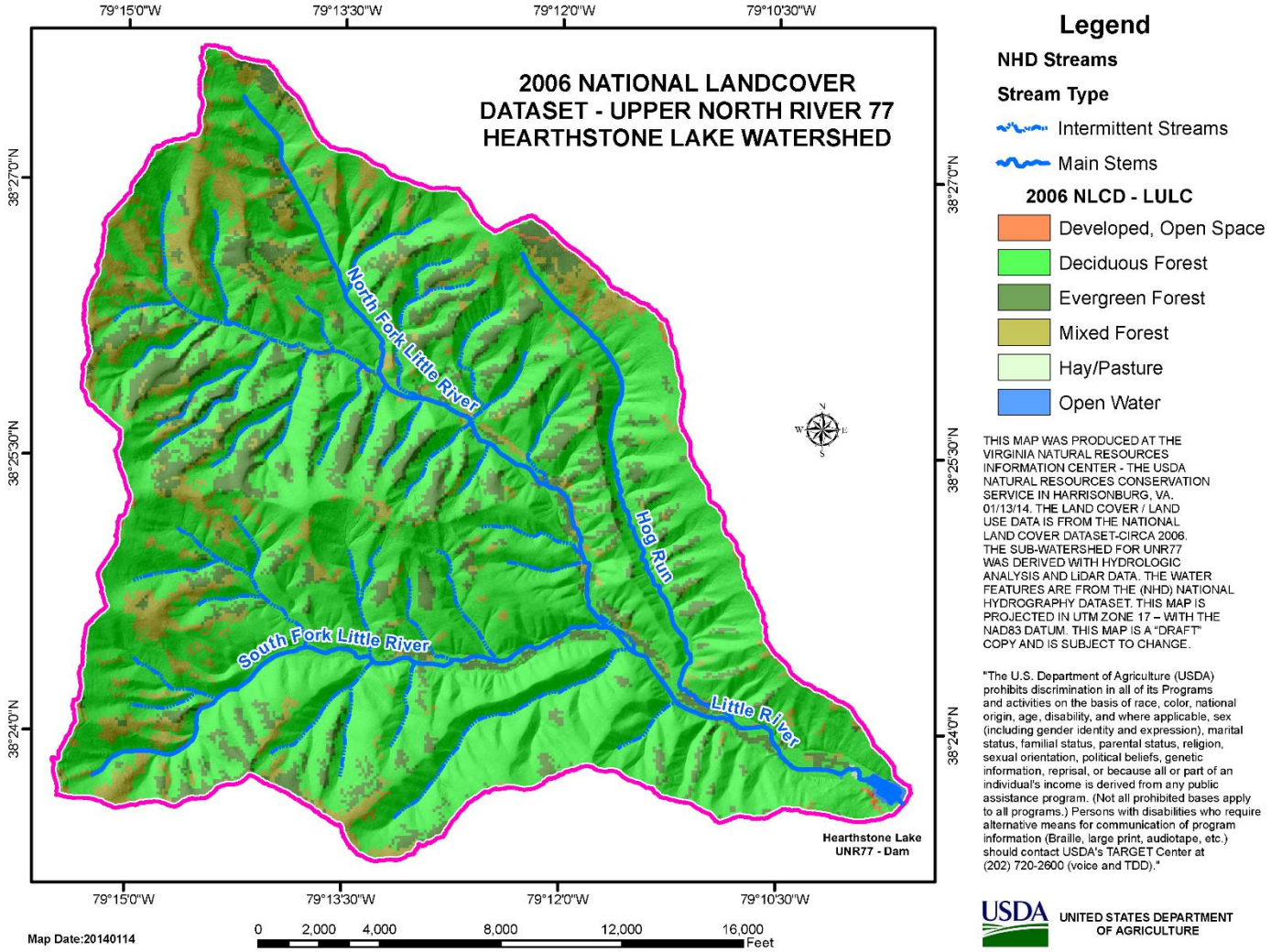

Figure B2. Hearthstone Lake Subwatershed with land use.

APPENDIX C

SUPPORT MAPS

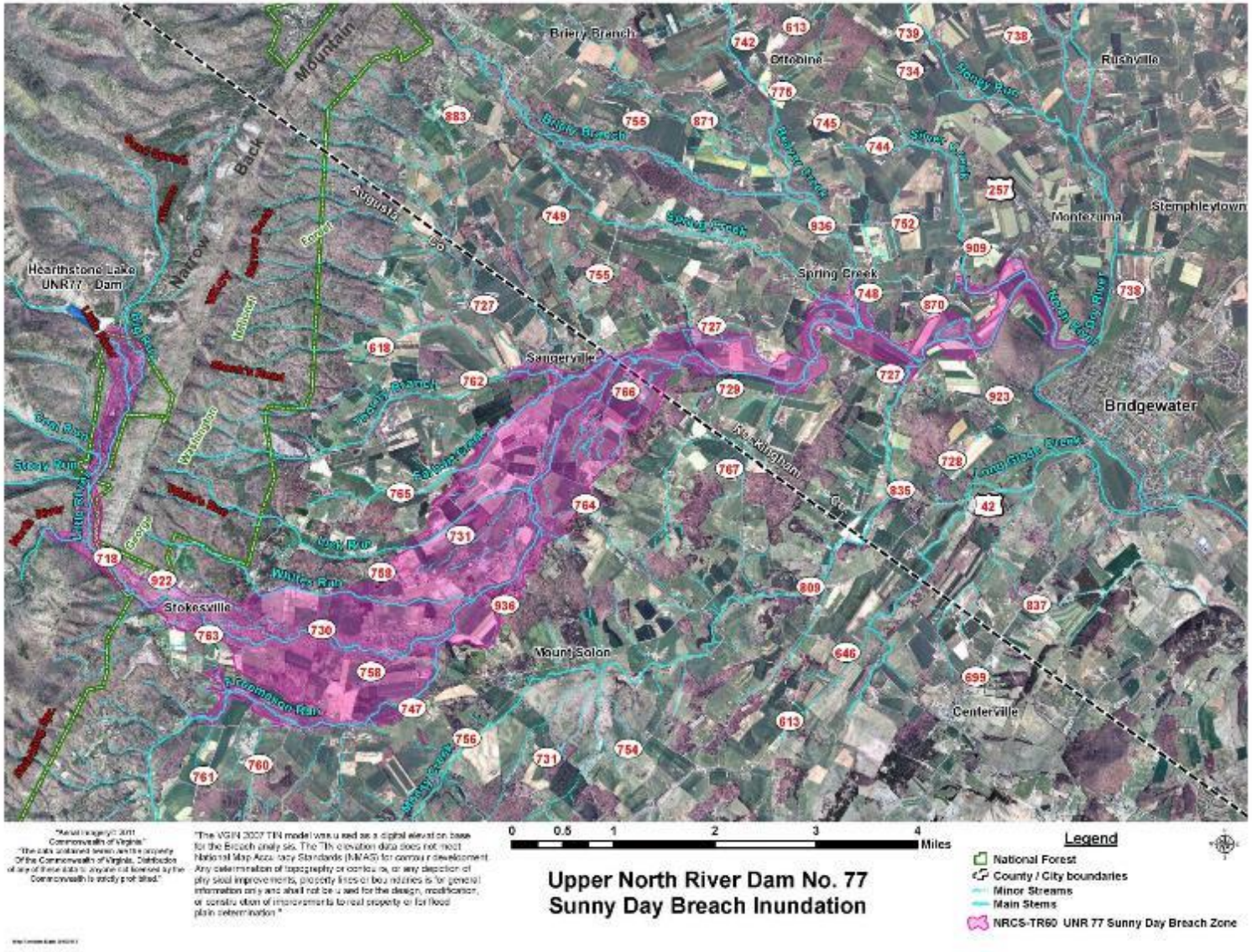

Figure C1. Sunny Day Breach Inundation Map.

Table C1 - Results of a Dam Breach Routing for Hearthstone Lake

Location Description	Drainage Area (sq. mi.)	HEC-HMS model Junctions	HEC-RAS River Station (#)	NRCS TR60 Breach - Peak Discharge (cfs)	NRCS TR60 Breach - Peak Water Surface Elevation (ft)
Hearthstone Lake	16	Hearthstone Lake	197156	241519	1779.5
Confluence of North River and Little River	65	Jct8	184767	209934	1588.2
Town of Stokesville	66	Jct10	179178	185922	1531.5
Upstream of SR 758 (near Mt Solon)	67	JctL3A	172776	142014	1468.7
Downstream of SR 758 and upstream of SR 731 crossing (near Mt Solon and includes Freeman Run drainage)	77	JctL3B	158045	101882	1358.6
SR 764 road crossing		Jct L4A	149186	68621	1309.8
Augusta and Rockingham county line (Downstream of Sangerville and SR 766)	96	Jct L4B	144167	50023	1284.3
Upstream of SR 613/SR 727	101	Jct L5A	129804	33373	1239.5
Upstream of the Confluence of North River and Briery Branch	105	JctL5B	127642	27170	1229.8
Downstream of confluence of Briery Branch (Does not include Mossy Creek)	155	JctL13	53520	23279	1214.0
At the county boundary at Bridgewater	174	JctL8	39791	23279	1192.8

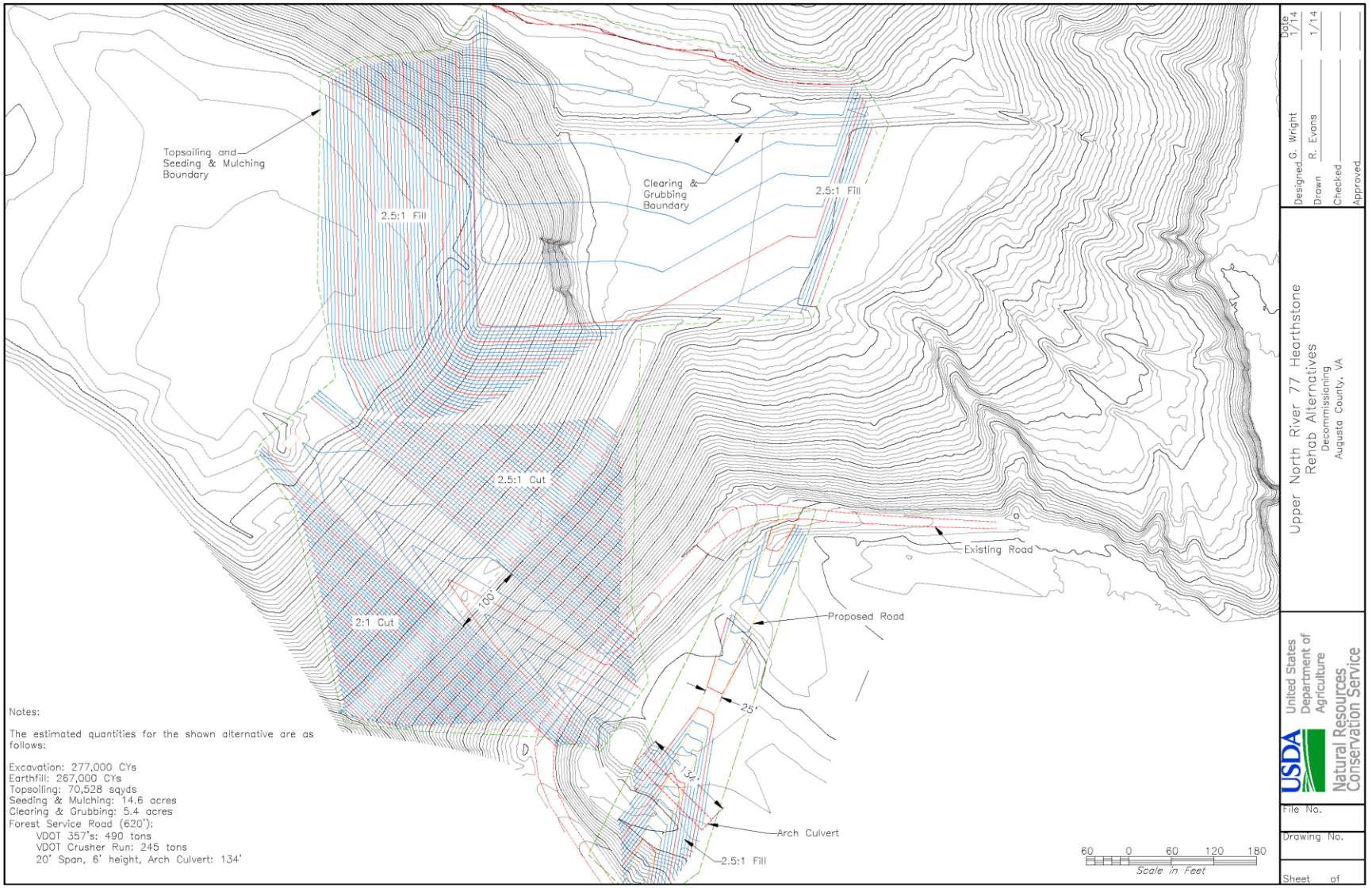

Figure C2. Plan view of site with partial decommissioning of the embankment.

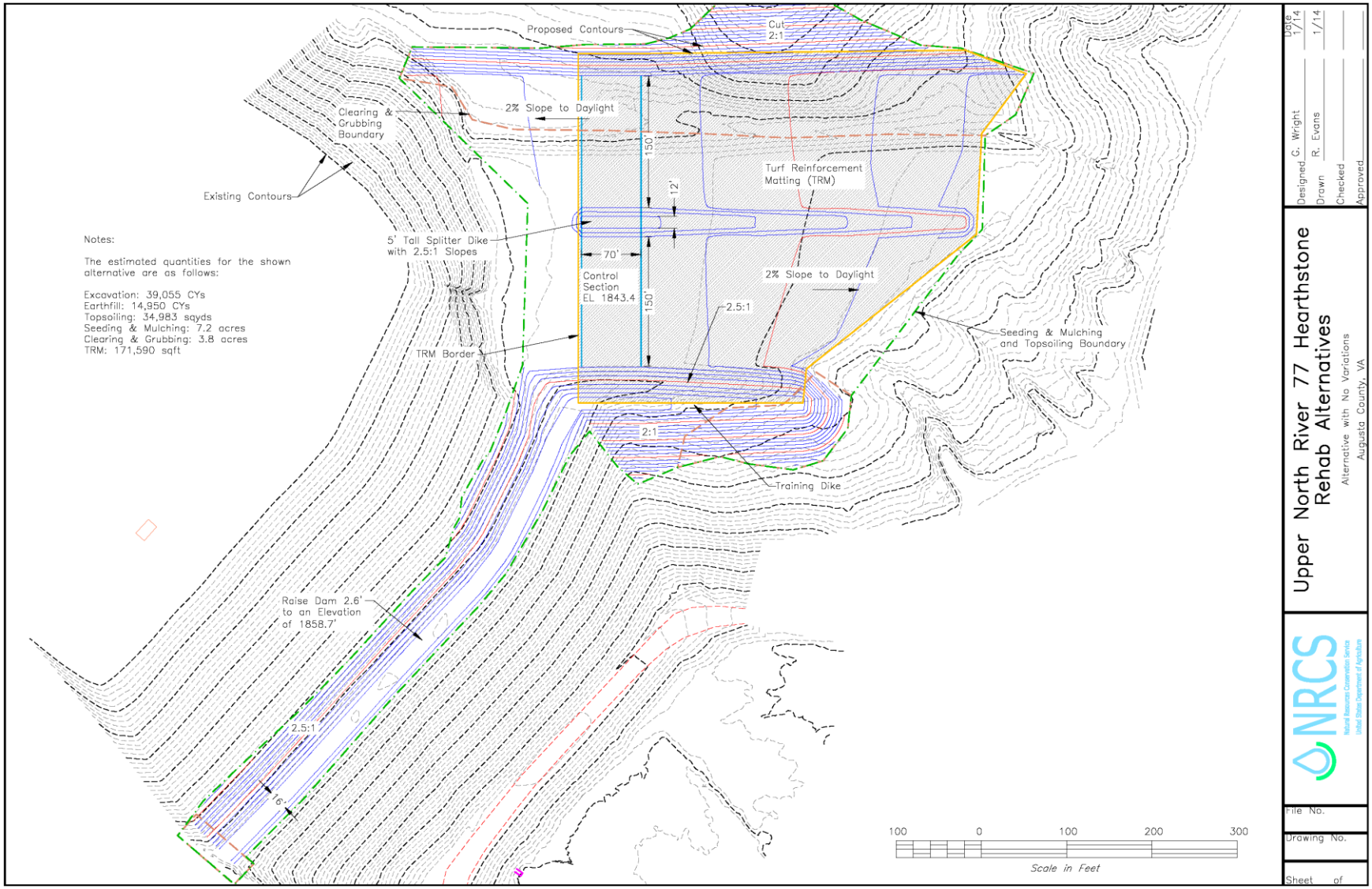

Figure C3. Plan view of Alternative.

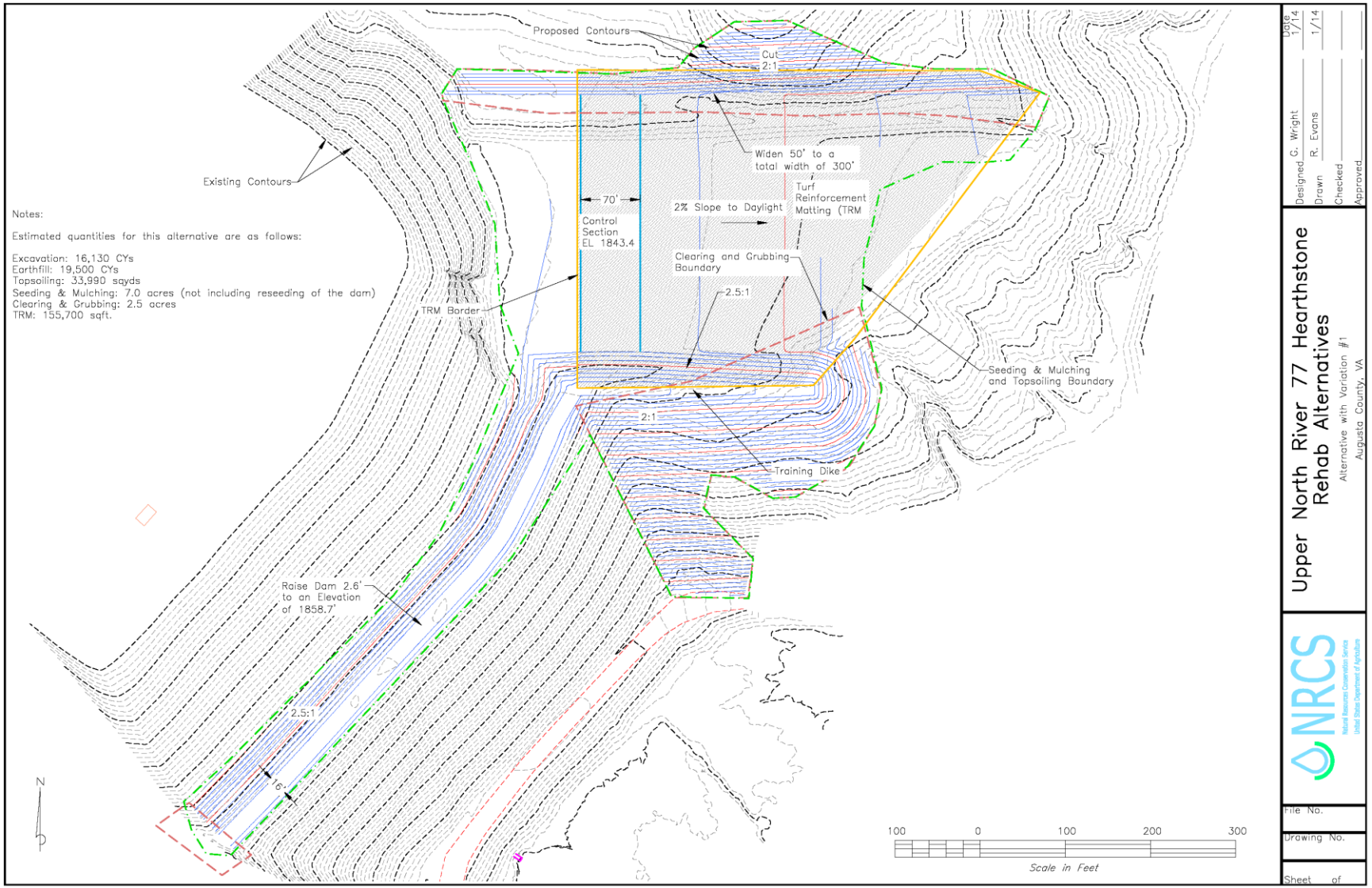

Figure C4. Plan view of Alternative with Variation 1 (no splitter dike).

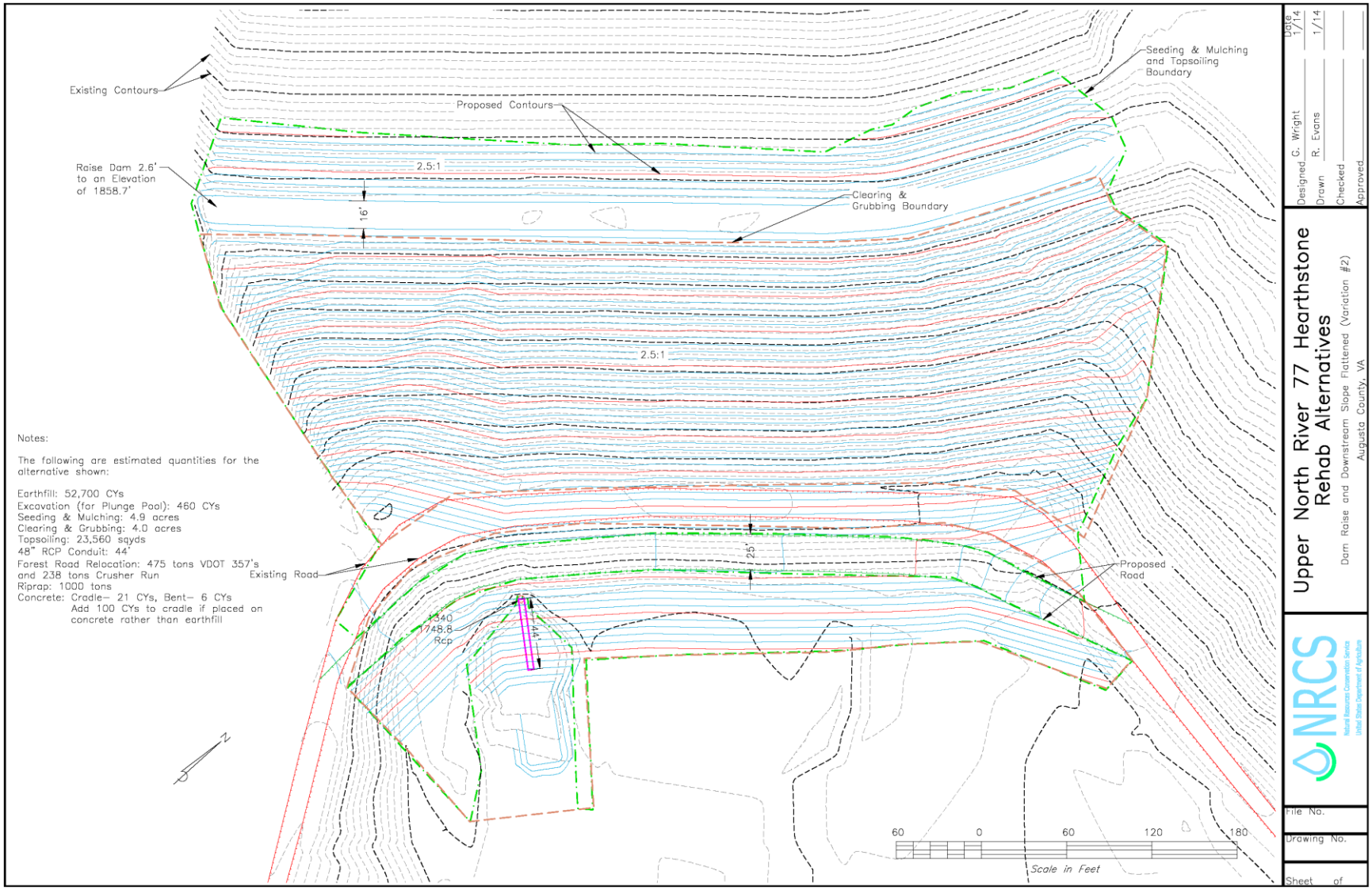

Figure C5. Plan view of Alternative with Variation 2 (with flattening of backslope).

APPENDIX D

INVESTIGATIONS AND ANALYSES REPORT

Investigation and Analysis Used in the Planning for the Rehabilitation of the Upper North River Dam Site No. 77 (Hearthstone Lake).

Threatened and Endangered Species: The U.S. Forest Service agreed to take the lead on investigations and inventories of endangered, threatened, and sensitive (TES) species and other responsibilities per the Endangered Species Act (ESA) and completed a Biological Evaluation (BE) and Biological Assessment (BA) per U.S. Forest Service policy. The U.S. Forest Service conducted database searches, field surveys, interviewed local experts, public scoping, and reviewed known locations of species known to inhabit the George Washington and Jefferson National Forest to investigate potential impacts to any TES. Additional information on methodology used for their TES investigations can be found in the BE/BA in Appendix E.

Cultural Resources, Natural and Scenic Areas, and Visual Resources: The U.S. Forest Service agreed to take the lead on inventories and investigations of cultural resources and other responsibilities per Section 106 of the National Historic Preservation Act. U.S. Forest Service cultural resources staff completed database searches for any known cultural resources and ground surveyed the project area for evidence of archaeological and/or historical resources that had the potential to be impacted in October 2014. Consultation with the Virginia Department of Historic Resources (VDHR) was initiated in November 2014 by the U.S. Forest Service with the submission of a cultural resources reconnaissance report pertaining to the proposed Todd Lake Dam rehabilitation project. On December 8, 2014, the VDHR indicated their concurrence with the U.S. Forest Service's finding of "*no historic properties affected"* for the proposed Todd Lake dam project.

The absence of Natural Heritage Resources, including Natural and Scenic Areas and Visual Resources, was determined by review of the Virginia Department of Conservation & Recreation Natural Heritage Resource Map for Augusta County and through a scoping letter received from the Virginia Department of Conservation & Recreation's Division of Natural Heritage.

Water Quality: Water quality data was taken from the Virginia DEQ 2012 305(b)/303(d) Integrated Water Quality Assessment and Impaired Waters Report.

Wetlands: A wetland investigation for Hearthstone Lake was completed during April 2014. Prior to conducting fieldwork, an off-site evaluation was completed. NRCS consulted the Stokesville USGS 7.5 minute Topographical Quadrangle Map, the National Wetlands Inventory Interactive Mapper (NWI), administered by the U.S. Fish and Wildlife Service, and soil survey information provided by NRCS. The USGS quad map shows a moderately sloping site within the floodplain of Little River. The NWI mapping depicts only the 14 acre open water wetland. Additionally, 7.86 acres of freshwater emergent wetlands were identified at the inflow of the lake. No additional wetlands were identified during the on-site investigation. Fieldwork was conducted using methods as outlined in the *1987 Corps of Engineers Wetland Delineation Manual*.

Forest and Wildlife Resources: Information on the forest and wildlife resources was obtained from field surveys and existing information from the U.S. Forest Service. Field surveys were conducted by U.S. Forest Service staff during the growing season of 2014.

Geology: Reference for this plan: The Geologic Map of Virginia, 1993, compiled by the Commonwealth of Virginia Department of Mines, Minerals, and Energy.

Sediment: NRCS performed the sediment survey in August 2012. Data was collected on a 50-foot grid across the entire surface of the lake. A total station was used to record the sediment depths. The quantity of sediment was determined by generating two surfaces in AutoCAD Civil 3D. The upper surface was defined as the top of the sediment and the lower surface was defined by the as-built cross-sections of the pool area.

HYDRAULICS AND HYDROLOGY

Background. Hydrologic and hydraulic investigations consisted of the following: an analysis of rainfall runoff relationships of the Hearthstone Lake watershed; an analysis capacity, stability and integrity of the existing dam and auxiliary spillway; and an analysis of a potential breach flood in the downstream floodplain.

Precipitation Data and Hydrologic Data. The 2004 NOAA-14, NOAA Hydrometeorological Report No. 51, and TR-60 precipitation data was used in the evaluation.

Description	Design Hydrograph	Duration (hrs)	Amount (in)	Source
100-year	PSH (rainfall)	1-day	6.67	Atlas 14
100-year	PSH (rainfall)	10-day	9.61	Atlas 14
100-year	PSH (runoff)	1-day	3.25	TR-60
100-year	PSH (runoff)	10-day	6.50	TR-60
ASW Stability (P100 & PMP)	SDH	6	10.45	Atlas 14 & HMR-51
ASW Capacity and Integrity (PMP)	FBH	6	28.0	HMR-51
ASW Capacity and Integrity (PMP)	FBH	24	36.0	HMR-51

Land cover was determined from digital land use maps (USDA's National Land Cover Database 2006). Soil data was generated from digital soil data maps (USDA-NRCS' Soil Survey Geographic (SSURGO) database for Augusta County and Rockingham County, Virginia). A 2012 mosaic of LiDAR Bare Earth DEMs was used as an elevation base to derive watershed terrain information.

SITES Analysis. The SITES model was used to evaluate the capacity, stability and integrity of the existing structure and the auxiliary spillway alternatives. Geotechnical information was taken from the Timmons report. The NRCS Standard rainfall distribution was used for the 6-hour PMP. This is the dimensionless storm distribution from TR-60, Figure 2-4. The 5-point distribution was used for evaluation of the 24-hour PMP event. The 6-hour storm was found to be the critical duration for the Freeboard Hydrograph (FBH).

The existing flood storage does not meet NRCS capacity criteria. The existing vegetated auxiliary spillway does not meet NRCS stability criteria but does meet NRCS integrity criteria.

The probability of the auxiliary spillway being activated at any given moment is 1/500, or 0.2%.

Water Surface Elevation Modeling and Breach Modeling. The potential impacts to downstream structures and people due to an instantaneous breach of the dam were evaluated to assist the economist with benefit estimates and to verify the hazard class of high. Below is a summary of the analysis.

Previous Studies by Others. The Sponsors have current break inundation zone maps for the dam that complies with the Virginia Impounding Structures Law and Regulations for high hazard dams. The Virginia Impounding Structures Regulations requires owners of high hazard dams to provide a dam break inundation zone map with multiple zones represented to determine hazard classification and develop the Emergency Action Plan (EAP). The spillway design flood for High Hazard dams is the Probable Maximum Flood (PMF), consistent with NRCS Freeboard Hydrograph criteria. The zones for a High Hazard dam include a sunny day dam failure using the volume at the auxiliary spillway crest, a spillway design flood (PMF) without a dam failure, and a dam failure during the spillway design flood (PMF). The break inundation report and maps are sealed by a Virginia professional engineer.

Hearthstone Lake was originally constructed in 1966 for the purpose of protecting downstream lands from flooding. It was designed as a SCS class (c) (high hazard) structure with a 50-year design life. The hazard class of the structure is high because failure may cause loss of life and serious infrastructure damage. The Sponsors have a current EAP on file for the dam that complies with the Virginia Impounding Structures law and regulations and NRCS policy for high hazard dams. The current EAP is dated January 2013.

The break inundation zone analysis and maps were approved by the Virginia Division of Dam Safety in February 2013. The Sponsors provided the hydrologic and hydraulic models to NRCS. The models and hydraulic data are consistent with NRCS policies and procedures for water surface modeling. These hydraulic models were used for further NRCS breach analysis, described below.

NRCS Breach Inundation Study and Maps – Water at ASW Crest. A sunny day breach analysis was performed in accordance with the peak breach discharge criteria in Technical Release No. 60, Earth Dams and Reservoirs (TR-60). It is assumed that structural collapse would occur instantaneously with the water level at the existing auxiliary spillway crest and result in a release of 2,970 acre-feet of water and sediment, beginning with a wall of water that is 60 feet high. The minimum breach discharge of 241,300 cfs was computed using the criteria in TR-60.

To determine the downstream inundation zone due to the minimum breach discharge, an analysis was performed from the dam downstream on Little River and North River to the Town of Bridgewater and Rockingham County line, more than 30 miles downstream of the dam. The breach analysis terminates 30 miles downstream of the dam, where the flow from the breach would be within the regulated 100-year floodplain.

The computer models HEC-HMS and HEC-RAS (steady flow) were used to determine the inundation zone due to the breach of the dam. The HEC-HMS rainfall-runoff model was used to route the minimum breach discharge through the existing structures and the downstream floodplain using reservoir and Muskingham-Crunge stream routing procedures. The peak flows at critical junctions, such as confluences and road crossings, were estimated and included in the HEC-RAS models.

The HEC-RAS (steady flow) water surface model developed by others and approved by the Virginia Division of Dam Safety was modified to model the TR-60 minimum breach discharge within the downstream floodplain. The breach inundation zone map was created in ArcGIS using the HEC-GeoRAS extension and using current aerial photography (VGIN 2011). The downstream structures and roads within the breach inundation zone are shown on the photography.

Identification of PAR and Impacted Structures. All of the structures in the potential breach impact zone of Hearthstone Lake were identified using GIS information provided by Augusta and Rockingham Counties. This was determined by overlaying the Sunny day breach inundation zone and the Augusta and Rockingham real estate data. This data includes current land ownership and description of associated improvements. This data includes single family dwellings, multiple family dwellings, businesses, gas stations, churches, recreational areas, and government infrastructure.

Once the type of structure was identified, the number of people that are reasonably expected in the breach inundation zone was estimated using Virginia NRCS references ACER11 and state laws and regulations. The table below describes the population at risk per structure type and the number of structures in the Sunny day breach inundation zone.

Structure	**PAR (Population at Risk)**	**No. of Structures in the Sunny day breach inundation zone**
Business	4	8
Church	1	3
Club	1	2
Mobile Home	2.5	28
Modular Home	2.5	7
Recreational	2.5	30 [1/]
Single Family	2.5	188
Multi Family	10	2

[1/] Camp May Flather has multiple buildings in the Girl Scout Camp but the camp was evaluated as a single site.

Within the NRCS Sunny day breach inundation zone, the population at risk is 630.

SOCIAL AND ECONOMIC CONDITIONS

Sources for the data included in the social and economic conditions section of this supplement include the U.S. Census Bureau, Department of Commerce, 2010 Census, and 2009-2013 Census projections.

Economic Analysis: The NRCS National Watershed Manual was used as a reference for the economic analysis along with two economic analysis guidance documents: "Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G), December, 1983, and the "Economics Handbook, Part II for Water Resources", USDA/Natural Resources Conservation Service, July, 1998. These guidance documents were used to evaluate potential flood damages, and estimate project benefits and associated costs. P&G was developed to define a consistent set of project formulation and evaluation instructions for all federal agencies that carry out water and related land resource implementation studies. The basic objective of P&G is to determine whether or not benefits from project actions exceed project costs. P&G also allows for abbreviated procedures to be used (section 1.7.2 (a) (4) (ii)), when more detailed analysis will not alter identification of the recommended National Economic Development alternative. In this case, the future without federal project and the future with federal project involve the same least-cost alternative with comparable scope, effects, benefits and costs. Therefore, no net change in benefits occurs when comparing the two candidate plans to each other.

Assessed values for all homes and other properties within the breach inundation zone were obtained from local government sources within the watershed and used to estimate damages from a possible catastrophic breach. Estimated flood damages were based on the results of the hydrology and hydraulics (H&H) simulation modeling indicating that a maximum peak discharge average depth of 3ft. would be experienced outside of the stream channel should a breach event occur. This assumed depth of flood water data was then used with water depth to damage functions developed by the Federal Emergency Management Agency (FEMA) to estimate structural damages. Content values were then estimated as a function of assessed property values.

All costs of installation, operation and maintenance were based on 2014 prices. The costs of associated with designing and implementing all structural measures were assumed to be implemented over a two-year installation period (1 year for design and 1 year for construction) and to have a 68-year useful life. Thus, a 70 year period of analysis was used along with the mandated 3.375% discount rate for all federal water resource projects for FY15 to discount and amortize the anticipated streams of costs and benefits.

Extending the expected useful life of the project to 100-years would require dredging to establish sufficient sediment pool storage capacity. Such an action would entail significant added costs, but no added benefits. Therefore, such an alternative was considered, but not developed in detail.

APPENDIX E

OTHER SUPPORTING INFORMATION

Biological Evaluation/Biological Assessment
for
Threatened, Endangered, and Sensitive (TES) Species

Hearthstone Lake Rehab

North River Ranger District
George Washington and Jefferson National Forests
Augusta County, Virginia

Introduction

Forest Service Manual (FSM) Section 2672.41 requires a biological evaluation (BE) and/or biological assessment (BA) for all Forest Service planned, funded, executed, or permitted programs and activities. The objectives of this BE/BA are to: 1) ensure that Forest Service actions do not contribute to trends toward federal listing, 2) comply with the requirements of the Endangered Species Act (ESA) so that federal agencies do not jeopardize or adversely modify critical habitat (as defined in ESA) of federally listed species, and 3) provide a process and standard to ensure that threatened, endangered, proposed, and sensitive species receive full consideration in the decision-making process.

The North River Ranger District supports known occurrences and suitable habitat for several TES species, all of which were considered in this analysis. This BE/BA documents the analysis of potential effects of the proposed project to TES species and associated habitat. It also serves as biological input into the environmental analysis for project-level decision making to ensure compliance with the ESA, National Environmental Policy Act (NEPA), and National Forest Management Act (NFMA).

Proposed Management Action

The proposed project is to rehabilitate Hearthstone Dam so that it is compliance with State regulations. Currently, the dam's auxiliary spillway does not have sufficient capacity and could allow the dam to be overtopped. Also, the vegetated earthen spillway does not have the stability to pass very large flows without eroding. To address this, the auxiliary spillway needs to be enlarged. In addition, the downstream slope of the embankment needs to be flattened for safe mowing operations.

The project was designed knowing the area is potential habitat for the Indiana bat and Forest Plan standards for its management will be followed.

Project Area and Cumulative Effects Analysis Area

The geographic scope of this biological analysis for terrestrial plants and animals is the project area. The geographic scope of the analysis for the Indiana bat is the entire George Washington and Jefferson National Forests (GWJNF). With regard to aquatic T&E species, this project does not lie in a 6th level HUC watershed included in the "Federally Listed Endangered and Threatened Mussel and Fish Conservation Plan".

This project area is comprised primarily of the oak forests and woodlands and pine forest and woodlands ecosystems, and areas that have been converted to grasses and forbs.

Future Actions

The agency knows of no specific activities planned on private land in the Hearthstone Lake watershed. Activities on private land within this watershed are expected to remain the same as current for the next 10 years. Other than the proposed actions described, there are no foreseeable future projects planned on National Forest System (NFS) land within the project area that may have an effect on terrestrial or aquatic plants and animals.

Species Reviewed

Federally listed threatened and endangered species, species proposed for federal listing and Southern Region sensitive species (TES) that may potentially be affected by this project were examined using the following existing available information:

1. Reviewing the list of TES plant and animal species known or likely to occur on the George Washington and Jefferson National Forests, and their habitat preferences. This review included the U.S. Fish and Wildlife Service current list of endangered, threatened, and proposed species for the Forest, dated January 17, 2003, and the August 7, 2001 Southern Region Sensitive Species list, revised for known or possible Forest occurrences on March 1, 2004 (list attached as Appendix A) with Forest-specific updates current as of March 1, 2004.

2. Consulting element occurrence records (EOR's) for TES species as maintained by the Virginia Division of Natural Heritage (VDNH), and supplied to the Forest.

3. Consulting species information, including county occurrence records, as maintained in the online database (http://www.vafwis.org/wis/asp/default.asp) titled Virginia Fish and Wildlife Information Service (VAFWIS) of the Virginia Department of Game and Inland Fisheries (VDGIF).

4. Consulting with individuals in the private and public sector who are knowledgeable about the area and its flora and/or fauna.

5. Reviewing sources listed in the reference portion of this report.

6. Reviewing the results of past field surveys that may have been conducted in the area.

Most TES species known to occur on the Forest have unique habitat requirements, such as shale barrens, rock outcrops, bogs, caves, and natural ponds. Information gathered, analyzed, and presented in the Southern Appalachian Assessment dated July 1996 states that approximately 84% of threatened and endangered species and 74% of sensitive species are associated with rare or unique habitats, often referred to as rare communities.

Through cooperative agreements between the Forest and VDNH, Special Biological Areas have been identified and delineated on the Forest. These include rare and significant natural communities and vegetative types along with the rare species they support. These areas reflect current knowledge on the location, management, and protection needs of rare species and associated significant natural communities on the Forest. These areas are identified in the George Washington Forest Plan as Special Interest Areas/Research Natural Areas (Management Area 4) and in a supplemental report from VDNH, dated July 2000 (Wilson, 2000), that identifies additional areas (called Conservation Sites by VDNH) for consideration as Special Biological Areas (SBAs). The Plan and these Special Biological Area reports were reviewed as part of this analysis. As a result of this review, no Special Biological Areas occur adjacent to the project area.

The need to conduct site-specific surveys of TES species for this project was assessed using direction in Forest Service Manual Supplement R8-2600-2002-2. Based on this assessment, affected potential habitat in the project area was surveyed for TES species. Appendix A of this document lists all 191 TES species currently known, or expected to occur, on or near the George Washington and Jefferson National Forests. All species on the list were considered during the analysis for this project.

A "step down" process was followed to eliminate species from future analysis and focus on those species that may be affected by proposed project activities. Species not eliminated are then analyzed in greater detail. Results of the "step down" analysis process are displayed in the Occurrence Analysis Results (OAR) column of the table in Appendix A. First, the range of a species was considered. Species' ranges on the Forest are based on county records contained in such documents as the Atlas of the Virginia Flora, but are refined further when additional information is available, such as more recent occurrences documented in scientific literature or in Natural Heritage databases. Many times range information clearly indicates a species will not occur in the project area due to the restricted geographic distribution of most TES species. When the project area is outside a known species range, that species is eliminated from further consideration by being coded as OAR code "1" in the Appendix A table. For this project, 140 species were eliminated from future consideration because the project area is not within the species known range.

For the remaining species, after this first step, a field survey was conducted to determine if suitable habitat or the species were present in the project area.

Field Survey and Results

Since some species could not be eliminated from further consideration based on known range, and because there were no existing field surveys in the project area, a field survey was necessary to determine the presence or absence of TES species and/or habitats. Mike Donahue, Biological Technician field inspected the project area on June 3, 2014, and Mike Donahue and Fred Huber, Forest Botanist, examined the area on August 20, 2014.

The field survey did not sample every acre, but was distributed throughout all habitat types found in the project area. The survey method consisted of walking through the project area searching for different habitat types and TES species occurrences. The plant survey utilized a meander search methodologies (Goff, Dawson, and Rochow, 1982) in which new habitat variations or unique areas are constantly being searched for in order to maximize floristic variation. The animal survey consisted of searching for individuals, signs of their presence (such as scat, tracks, calls, or nests), and/or potential habitat. The survey intensity was concentrated on potential sites of greatest ground disturbance.

From the field survey, species were eliminated from further consideration because of: a) Lack of suitable habitat in the project area (OAR code "2"); b) Habitat present and the species was searched for, but was not found (OAR code "3"); c) Species occurs in project area, but outside actual area of activity where ground disturbance will occur (OAR code "4"); and d) Aquatic species or habitat known or suspected downstream of project or activity area but outside of identified geographic bounds of water resource cumulative effects analysis area (defined as point below which sediment amounts are immeasurable and insignificant) (OAR code "7"). The results of the field survey(s) are documented in the Appendix A table. For this project, 48 species were eliminated from further consideration because of one of the above reasons.

Species Identified as Being in the Action Area or Potentially Affected by the Action:

From the field survey, those species which are analyzed and discussed further in this document are those that either: a) Field survey located species in the activity areas (OAR code "5"); b) Species not seen during the survey(s), but possibly occur in the activity area based on habitat observed during the survey(s) or field survey was not conducted when species is recognized (OAR code "6"); c) Aquatic species, known or suspected downstream of project or activity area and within identified geographic bounds of water resource cumulative effects analysis area (OAR code "8"); or d) Federally listed mussel and/or fish species know in 6th level watershed of project area. Conservation measures from USFS/FS Conservation Plan applied (OAR code "9").

As a result of this process, the following three species are potentially affected by the Proposed Action:

OAR Code	Scientific Name	Common Name	Taxa	TES
6	*Myotis septentrionalis*	Northern long-eared bat	Mammal	Proposed Endangered
6	*Myotis sodalis*	Indiana Bat	Mammal	Endangered
6	*Monotropis odorata*	Sweet pinesap	Vascular Plant	Sensitive

Other than potential habitat for these ten species no other TES species or potential habitats that may support TES species were found during the survey and fieldwork.

Effects of Proposed Management Action on Each Identified Species

The analysis of possible effects to species identified as known or expected to occur in the vicinity of the proposed project, or likely to be affected by the action includes the following existing information:

1. Data on species/habitat relationships.
2. Species range distribution.
3. Occurrences developed from past field surveys or field observations.
4. The amount, condition, and distribution of suitable habitat.

Effects to Species Listed or Proposed for Listing Under the Endangered Species Act

Effects to the Indiana Bat:

Effects to the federally endangered Indiana Bat (*Myotis sodalis*) were considered in this BE/BA because it is assumed the entire Forest is potential habitat for this species. See USFWS's Biological Opinion (BO) of September 16, 1997 and this agency's Environmental Assessment/Decision Notice of March 12, 1998 for the "Proposed Forest Plan Amendment for Management of the Federally Endangered Indiana Bat", herein referred to as the Bat Amendment EA (GW Amendment #6).

During past and recent surveys, no Indiana bats were seen in this part of the Forest even though potential habitat (mature forests with trees having exfoliating bark) exists across the entire

Massanutten Mountain area. The project area contains tree species of the size and type known to be used by the Indiana bat. Based upon professional judgment and known cave surveys, there are no caves with winter microclimate habitat conditions suitable for Indiana bats in the project area and the area is not within either the primary or secondary cave protection areas surrounding known hibernacula. The nearest cave with Indiana bat use documented is approximately 50 miles west in Pendleton County, WV.

During this project the immediate removal of hardwood trees greater than 9" dbh is very unlikely, but if it did occur it would result in some very minor loss of potential Indiana bat roost trees, and indirectly the potential, but very unlikely, loss of individual bats. Shagbark hickory and old snags with exfoliating bark along with large hollow cavity trees will not likely be affected.

This project-level analysis has tiered to the George Washington National Forest's Revised Forest Plan and Final Environmental Impact Statement (FEIS) as amended by the Bat Amendment EA. This project-level analysis includes, and is in addition to the entire Indiana bat effects analysis (pages 15 through 44) documented in the Bat amendment EA. Because of its length, the Bat Amendment EA's discussion is not repeated here. However, findings of that analysis concluded that individual bats might be killed or harmed by such activities as associated with this project. Yet the U. S. Fish and Wildlife Service have determined that such take, within authorized levels, would be incidental take, and would not result in jeopardy to the Indiana bat. The acres to be impacted, 28 acres of non-native pine removal, as proposed in this project are 0.6% of the 4,500 acres allowed to be altered annually under the incidental take provisions of the Indiana bat Biological Opinion.

In implementing this project, apply on the ground Forest-wide protection and project monitoring standards #314 to #326 (inclusive), Revised Plan replacement pages 3-160 to 3-162 (equates to #13 to #25 of GW Plan Amendment #6 attached to DN).

There is potential unoccupied habitat for the Indiana bat within the project area, but with implementation of measures described in the BO under the Terms and Conditions section of the Incidental Take Statement, there will be no cumulative effects.

The U. S. Fish and Wildlife Service supported the determination for the Indiana bat as follows: In the September 16, 1997 U. S. Fish and Wildlife Service's Biological Opinion concerning the Indiana bat on the Forest the following conclusion was reached, "After reviewing the current status of the Indiana bat, the environmental baseline for the action area, the effects of forest management and other activities on the GWJNFs, the Indiana Bat Recovery Strategy presented in the GWJNFs biological assessment, and the cumulative effects, it is the Service's biological opinion that forest management and other activities authorized, funded, or carried out on the GWJNFs, are not likely to jeopardize the continued existence of the Indiana bat. Critical habitat for this species has been designated in Kentucky, Tennessee, Illinois, Missouri, and West Virginia. However, this action does not affect those areas and no destruction or adverse modification of that critical habitat will occur as a result of GWJNFs management activities". There are no foreseeable activities in the area that would directly affect the Indiana bat. Therefore, there will be no cumulative effects to the Indiana bat.

Effects to the Northern Long-eared Bat

This species was considered because it has been recorded as occurring throughout Virginia. It is currently proposed for listing under the Endangered Species Act mainly because of population declines caused by White Nose Syndrome (WNS). The range of the northern long-eared bat includes much of the eastern and north central United States, and all Canadian provinces from the Atlantic Ocean west to the southern Yukon Territory and eastern British Columbia. Northern long-eared bats spend winter hibernating in caves and mines. They typically use large caves or mines with large passages and entrances; constant temperatures; and high humidity with no air currents. Specific areas where they hibernate have very high humidity, so much so that droplets of water are often seen on their fur. Within hibernacula, surveyors find them in small crevices or cracks, often with only the nose and ears visible. During summer, northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat seems opportunistic in selecting roosts, using tree species based on suitability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds. Breeding begins in late summer or early fall when males begin swarming near hibernacula. After copulation, females store sperm during hibernation until spring, when they emerge from their hibernacula, ovulate, and the stored sperm fertilizes an egg. After fertilization, pregnant females migrate to summer areas where they roost in small colonies and give birth to a single pup. Maternity colonies, with young, generally have 30 to 60 bats, although larger maternity colonies have been observed. Most females within a maternity colony give birth around the same time, which may occur from late May or early June to late July, depending where the colony is located within the species' range. Young bats start flying by 18 to 21 days after birth. Adult northern long-eared bats can live up to 19 years. Northern long-eared bats emerge at dusk to fly through the understory of forested hillsides and ridges feeding on moths, flies, leafhoppers, caddisflies, and beetles, which they catch while in flight using echolocation. This bat also feeds by gleaning motionless insects from vegetation and water surfaces (USFWS Fact Sheet 2013).

The USFWS 12-month Listing Package for the northern long-eared bat (78 Federal Register 191) states: "Predominantly due to the emergence of WNS, the northern long-eared bat has experienced a severe and rapid decline in the Northeast, estimated at approximately 99 percent (from hibernacula data) since the disease was first discovered there in 2007. Summer survey data in the Northeast have confirmed rates of decline observed in northern long-eared bat hibernacula data post-WNS, with rates of decline ranging from 93 to 98 percent. This disease is considered the prevailing threat to the species, as there is currently no known cure" (Federal Register 10/02/2013, 78 FR 61045 61080). In response to the WNS threat the Forest has closed all caves and mines to public use per an annually renewed Southern Region closure order that began May 21, 2009, to reduce the potential for WNS to be spread via human use of caves. Caves on the Forest that are currently gated will remain closed with gates locked year-round.

The 12-month listing also identifies prescribed burning, timber harvest, and other forest management as activities that alone do not have significant effects, but which cumulatively with the effects of WNS, may further impact the northern long-eared bat. Literature cited in the 12-month listing and other recently published research (Johnson et al. 2009) shows that the northern long-eared bat responds favorably to vegetation practices that provide a range of successional stages in the forest. This response is reflected in the range of tree species preferred for day

roosts where the northern long-eared bat prefers black locust and sassafras snags and live trees with cavities (these trees are both early successional, shade intolerant species which require disturbance and open conditions to regenerate and become suppressed in the understory as forest canopies age and close with the lack of disturbances such as fire). There is also considerable evidence which shows female northern long-eared bats choose day roosts that have increased solar radiation and are often along edges of gaps and openings in the forest canopy. Recent studies of northern long-eared bat home range and habitat use analysis indicate northern long-eared bat selects forest stands for foraging which have been partially harvested more so than un-cut or open areas such as fields and along road corridors. This indicates that northern long-eared bat favors a structurally complex mosaic of closed and open forest canopy gap conditions across the landscape.

The George Washington Forest Plan and the Jefferson Forest Plan contain management direction for the protection of caves and bats. Both of these plans require that the majority of the forest remain in mature forest (stand ages greater than 70 years) and both have objectives to create early successional habitat through vegetation management to create a diversity of structure in the forest. In addition, both promote potential summer roost trees during timber harvest with requirements to protect trees such as shagbark hickory with furrowed and exfoliating bark and to leave most existing snags or cavity trees.

Effects to Sensitive Species

Sweet Pinesap:

Effects to sweet pinesap (*Monotropsis odorata*) were considered in this BE/BA because the species is known to occur in Page County and potential habitat occurs in the project area, however none were observed during field surveys. This species is known to occur in at least 20 Virginia counties and ranges from Maryland to Kentucky south to Florida. It is possible that individuals of this species may have been inadvertently missed during field surveys and past field work in the area. Sweet pinesap typically grows in well drained, dry to mesic, acidic soil in oak-heath woodlands, often with white pine and rhododendron. It flowers very early in the year (February to early April) and has been seen flowering when snow is on the ground. It is often overlooked since it grows well hidden under the leaf litter and is usually found by smell since it is quite fragrant. Historically, fires often burn in this vegetation type and fire may benefit the species by releasing nutrients and thinning understory vegetation. Since this plant flowers so early it's probable that it will have flowered by the time the prescribed burn is implemented. If not, then plants would be top killed in the leaf litter but should resprout from the root mass which is under the moist duff at the soil-leaf litter interface.

Determination of Effect

For the Indiana bat this project will be in compliance with the BO issued by the USFWS on September 16, 1997 and therefore constitutes compliance with ESA Section 7 requirements. Since implementation of this project will be in compliance with, and tiers to, the BO that was issued as a result of formal consultation and it provides both specific Plan and project level direction, plus no new information has been identified as of this date, a finding of the effect to the Indiana bat for this proposed project is: "no affect, beyond that which is already disclosed in the Biological Assessment on Indiana bats dated April 30, 1997 and by the USFWS in the BO of September 16, 1997." Therefore, given the project level analysis for the Indiana bat and the

authorized level of incidental take, further Section 7 consultation is not necessary for the Indiana bat.

For the Northern long-eared bat, based on the positive action of closing caves and mines, the habitat objectives to maintain a variety of successional classes within a matrix of a predominantly mature forest structure, and the current standards put in place to protect cave and karst locations along with specific management standards for the Indiana bat, we do not believe there is any likelihood that the management activities implemented during the next year will jeopardize the continued existence of the northern long-eared bat. In addition, since we are going through informal consultation on any projects that may affect the Indiana bat, the US Fish and Wildlife Service will be examining all projects that may affect the northern long-eared bat, should something be proposed that is different than our standard practices.

Because there are no other T&E species or associated habitat present, the proposed project will have no effect on any other federally listed or proposed species.

For the sweet pinesap there will be no negative impact that would cause a loss of species viability on the Forest or cause a trend towards federal listing under the ESA.

Because there were no other sensitive species (other than the nine already addressed) or habitat present, the project will have no impact to any Southern Region sensitive species.

Persons Consulted:

Steve Croy – Forest Ecologist

Prepared by:

/s/ Fred Huber

FRED HUBER Date: October 24, 2014
Forest Botanist

Attachments: References
Appendix A – Forest TES List

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APPENDIX A
Documentation of Threatened, Endangered or Sensitive Species Occurrences for Hearthstone Lake Rehab
Coding for Occurrence Analysis Results (OAR) for 191 species

Forest updated February 24, 2014 (based on Region 8 sensitive species list effective January 1, 2002)

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
VERTEBRATE										
Fish										
1	-	X	*Ammocrypta clara*	Western sand darter	Clinch R, Powell R	Aquatic-rivers	S	G3	S1	-
1	-	X	*Cottus baileyi*	Black sculpin	Little R, Upper Clinch R, S Fk Holston R	Aquatic-streams	S	G4Q	S2	-
1	-	X	*Erimonax monachus*	Spotfin chub	Lower N Fk Holston R	Aquatic-streams	T	G2	S1	-
1	-	X	*Erimystax cahni*	Slender chub	Two sites - Powell R, Lee Co	Aquatic-rivers	T	G1	S1	-
1	-	X	*Etheostoma acuticeps*	Sharphead darter	S and Middle Fk Holston R	Aquatic-rivers	S	G3	S1	-
1	-	X	Etheostoma susanae	Cumberland Johnny darter	Endemic to Upper Cumberland R watershed near VA	Aquatic-streams	PE	G2	S1 (KY)	-
1	-	X	*Etheostoma osburni*	Candy darter	Big Stony Ck, Laurel Fork in New R watershed	Aquatic-streams	S	G3	S1	S2
1	-	X	*Etheostoma percnurum*	Duskytail darter	Copper Ck, Clinch R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Etheostoma tippecanoe*	Tippecanoe darter	Four sites Clinch R, lower Copper Ck	Aquatic-rivers	S	G2	S1	S2
1	-	X	*Icthyomyzon greeleyi*	Mountain brook lamprey	M, N Fk Holston R, Copper Ck, Indian Ck, Clinch R, Powell R	Aquatic-rivers	S	G3G4	S2	S1
1	-	X	*Notropis ariommus*	Popeye shiner	N Fk Holston R, Clinch R, Powell R	Aquatic-rivers	S	G3	S2S3	S2
1	X	X	*Notropis semperasper*	Roughhead shiner	Upper James R watershed above Buchanan	Aquatic-rivers	S	G2G3	S2S3	-
1	-	X	*Noturus flavipinnis*	Yellowfin madtom	Lower & Mid reaches of Copper Ck, Powell R	Aquatic-streams	T	G1	S1	-
1	X	X	*Noturus gilberti*	Orangefin madtom	S Fk Roanoke R watershed, Roanoke R above Salem, Craig Ck, Johns Ck, Cowpasture R	Aquatic-streams	S	G2	S2	-
1	-	X	*Percina burtoni*	Blotchside logperch	N Fk Holston R, Clinch R, Copper Ck, Little R	Aquatic-rivers	S	G2G3	S1	-
1	-	X	*Percina williamsi*	Sickle darter	N Fk Holston R above Saltville, lower Copper Ck	Aquatic-rivers	S	G3	S1S2	S2
1	-	X	*Percina rex*	Roanoke logperch	Upper Roanoke R watershed	Aquatic-rivers	E	G1G2	S1S2	-
1	-	X	*Phenacobius crassilabrum*	Fatlips minnow	Unimpounded lower S Fk Holston R, Whitetop Laurel Ck	Aquatic-rivers	S	G3G4	S2	-
1	-	X	*Phenacobius teretulus*	Kanawha minnow	Upper New R watershed	Aquatic-streams	S	G3G4	S2S3	S1
1	-	X	*Chrosomus cumberlandensis*	Blackside dace	Upper Cumberland R, Upper Powell R, Poor Fk Cumberland R	Aquatic-streams	T	G2	S1	S3 (KY)
1	-	X	*Chrosomus tennesseensis*	Tennessee dace	Lick Ck, N Fk Holston R, Beaverdam Ck, M Fk Holston R	Aquatic-streams	S	G3	S1	-
Amphibian										
1	-	X	*Plethodon hubrichti*	Peaks of Otter salamander	Peaks of Otter, Apple Orchard Mtn	Mixed oak, late successional with loose rocks and logs, >1800'.	S	G2	S2	-
1	X	-	*Plethodon punctatus*	Cow Knob salamander	Shenandoah Mtn, VA & WV	Mixed oak, late successional with loose rocks and logs, >2500'.	S	G3	S2	S1
1	-	-	*Plethodon shenandoah*	Shenandoah salamander	Three isolated populations in SNP: Hawksbill Mtn, The Pinnacles, Stony Man Mtn. GW occurrence questionable.	Talus slopes. Erroneous records from Three Ridges, The Priest, Pompeii on the Pedlar.	E	G1	S1	-
1	-	X	*Plethodon welleri*	Weller's salamander	Mt Rogers & Whitetop Mtn	Spruce-fir forests and adjacent northern hardwoods.	S	G3	S2	-
Bird										
2	X	X	*Falco peregrinus*	Peregrine Falcon	Hack sites late 80s and early 90s – Mt Rogers, Grayson; Cole Mtn, Amherst; Big Schloss, Shenandoah; Elliot Knob, Augusta; High Knob, Rockingham Cos. No nests, current migrant.	Nests on ledges or cliffs, buildings, bridges, quarry walls. Non-breeding sites, farmland, open country, lakeshores, broad river valleys, airports, cities. Prefers pigeons, ducks.	S	G4	S1B/S2N	S1B/S2N
2	X	-	*Haliaeetus leucocephalus*	Bald Eagle	Potomac R, James R, New R, Upper Tennessee watersheds	Feeds and nests on or near large lakes and rivers.	S	G5	S3S4B/S3S4N	S2B/S3N
2	X	-	*Lanius ludovicianus migrans*	Migrant Loggerhead Shrike	Ridge & Valley (Shenandoah Valley)	Open grasslands with trees and shrubs, fencerows.	S	G4	S2B/S3N	S1B/S2N
2	X	X	*Thryomanes bewickii altus*	Appalachian Bewick's Wren	Historical records in Botetourt, Giles, Highland Washington Cos.	Thickets, old fields, fencerows, old home sites.	S	G5T2Q	SHB/S1N	S1B/S1N
Mammal										
2	X	X	*Corynorhinus townsendii virginianus*	Virginia big-eared bat	Summer: VA - Tazewell Co (3 caves), Highland Co (1 cave); WV - Pendleton Co (4 caves); Winter: Highland, Rockingham, Bland, and Tazewell Cos (6 caves); Pendleton Co (6 caves). Largest VA population in Tazewell Co and largest WV population in Pendleton Co. Small numbers of bats (usually <10) in a few other widely scattered caves during summer months. Bath & Pulaski Co records are historic. No occupied caves currently known on Forest.	Resides in caves winter and summer. Short distance migrant (<40 miles) between winter and summer caves. Forages primarily on moths and foraging habitat is common (fields, forests, meadows, etc.). Forages within 6 miles of summer caves. USFWS Critical Habitat is 5 caves in WV (4 Pendleton Co and 1 Tucker Co). Closest Critical Habitat cave to GWJNF is ~3 miles in Pendleton Co, WV. OAR code of "2" used when project further than 6 miles from summer or winter occupied cave.	E	G3G4T2	S1	S2
1	-	X	*Glaucomys sabrinus coloratus*	Carolina northern flying squirrel	Mt Rogers & Whitetop area	Spruce-fir forests and adjacent northern hardwoods.	E	G5T2	S1	-
1	X	-	*Glaucomys sabrinus fuscus*	Virginia northern flying squirrel	Laurel Fork area, Highland Co	Spruce forests and adjacent northern hardwoods.	E	G5T2	S1	S2
1	X	-	*Microtus chrotorrhinus carolinensis*	Southern rock vole	Alleghany Mtn, Bath Co	Cool, moist, mossy talus under oaks/northern hardwoods.	S	G4T3	S1	S2
1	-	X	*Myotis grisescens*	Gray bat	Ridge & Valley, Clinch R watershed	Caves winter and summer, forages widely.	E	G3	S1	-

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
2	X	X	*Myotis leibii*	Eastern small-footed bat	Ridge & Valley	Hibernates in caves during winter, roosts in crevices of large rock outcrops, cliffs, and under large rocks in talus & boulder-fields during summer, plus similar man-made structures like rip-rap and bridges, forages widely in all forested and open habitat types over both ridges and valleys.	S	G3	S2	S1
6	X	X	*Myotis septentrionalis*	Northern long-eared bat	Blue Ridge, Ridge & Valley, Cumberland Mtns	Hibernates in crevices and cracks of cave walls during winter (sometimes mines & tunnels), difficult to find and rarely seen. During summer, forages widely and roosts singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. Also may roost in structures like barns, sheds, & houses.	PE	G2G3	S3	S3S4
6	X	X	*Myotis sodalis*	Indiana bat	Blue Ridge, Ridge & Valley, Cumberland Mtns	Caves winter, upland hardwoods summer, forages widely along riparian areas and open woodlands.	E	G2	S1	S1
1	X	-	*Sorex palustris punctulatus*	Southern water shrew	Alleghany Mtn, Bath Co; Laurel Fork, Highland Co	Riparian areas w/in spruce-fir forests and northern hardwoods.	S	G5T3	S1S2	S1
INVERTEBRATE										
Snail (Mollusk, Class Gastropoda)										
1	X	X	*Glyphyalinia raderi*	Maryland glyph	Alleghany, Montgomery Cos	Calciphile, edge of seeps within leaf litter.	S	G2	S1S2	S2
1	X	-	*Helicodiscus diadema*	Shaggy coil	Alleghany Co	Calciphile, limestone rubble and talus.	S	G1	S1	-
1	X	-	*Helicodiscus lirellus*	Rubble coil	Rockbridge Co	Calciphile, limestone rubble and rich fossiliferous shale talus.	S	G1	S1	-
1	X	X	*Helicodiscus triodus*	Talus coil	Alleghany, Botetourt, Rockbridge Cos	Calciphile, limestone rubble on wooded hillsides and near cave entrances.	S	G2	S1S2	SH
1	-	X	*Io fluvialis*	Spiny riversnail	Clinch R, N Fk Holston R	Aquatic-rivers	S	G2	S2	-
1	-	X	*Paravitrea reesi*	Round supercoil	Monroe, WV	Calcareous woodlands and glades.	S	G3	S2	S1
Mussel (Mollusk, Class Bivalvia)										
2	X	-	*Alasmidonta varicosa*	Brook floater	Potomac drainage	Aquatic-rivers	S	G3	S1	S1
1	-	X	*Cumberlandia monodonta*	Spectaclecase	2 sites Clinch R	Aquatic-rivers	E	G3	S1	-
1	-	X	*Cyprogenia stegaria*	Fanshell	Lower Clinch R, Scott Co	Aquatic-rivers	E	G1Q	S1	S1
1	-	X	*Dromus dromas*	Dromedary pearlymussel	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G1	S1	-
1	X	X	*Elliptio lanceolata*	Yellow lance	Roanoke R, James R	Aquatic-rivers	S	G2G3	S2S3	-
1	-	X	*Epioblasma brevidens*	Cumberlandian combshell	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Epioblasma capsaeformis*	Oyster mussel	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Epioblasma florentina aureola*	Golden riffleshell	Clinch R, M Fk Holston R, N Fk Holston R	Aquatic-rivers	E	G1T1Q	S1	-
1	-	X	*Epioblasma torulosa gubernaculum*	Green-blossom pearlymussel	Clinch R, N Fk Holston R	Aquatic-rivers	E	G2TX	SX	-
1	-	X	*Epioblasma triquetra*	Snuffbox	Clinch R, Powell R, N Fk Holston R	Aquatic-rivers	E	G3	S1	S2
1	-	X	*Fusconaia cor*	Shiny pigtoe	Clinch R, Powell R, N Fk Holston R, Copper Ck	Aquatic-rivers	E	G1	S1	-
1	-	X	*Fusconaia cuneolus*	Fine-rayed pigtoe	Clinch R, Powell R, Copper Ck, Little R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Fusconaia masoni*	Atlantic pigtoe	Roanoke R, Craig Ck drainage	Aquatic-rivers	S	G2	S2	-
1	-	X	*Hemistena lata*	Cracking pearlymussel	Clinch R, Powell R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Lampsilis abrupta*	Pink mucket	Clinch R	Aquatic-rivers	E	G2	SX	S1
1	-	X	*Lasmigona holstonia*	Tennessee heelsplitter	Upper Clinch, N and M Fk Holston R drainages; Wolf Ck, Bland Co below Burkes Garden	Aquatic-streams	S	G3	S1	-
2	X	-	*Lasmigona subviridis*	Green floater	Widely distributed in N & S Fk Shenandoah R, Pedlar R, James R	Aquatic-rivers	S	G3	S2	S2
1	-	X	*Lemiox rimosus*	Birdwing pearlymussel	Clinch R, Powell R, Copper Ck, Little R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Pegias fabula*	Little-winged pearlymussel	Clinch R, N Fk Holston R, S Fk Holston R, Little R	Aquatic-streams	E	G1	S1	-
1	-	X	*Plethobasus cyphyus*	Sheepnose	Clinch R, Powell R	Aquatic-rivers	E	G3	S1	S1
1	X	X	*Pleurobema collina*	James spinymussel	Potts Ck, Craig Ck, Johns Ck, Patterson Run, Pedlar R, Cowpasture R, Mill Ck (Deerfield)	Aquatic-rivers	E	G1	S1	S1
1	-	X	*Pleurobema cordatum*	Ohio pigtoe	Clinch R	Aquatic-rivers	S	G4	S1	S2
1	-	X	*Pleurobema oviforme*	Tennessee clubshell	Clinch R, Powell R, N, Middle, S Fk Holston R	Aquatic-streams	S	G2G3	S2S3	-
1	-	X	*Pleurobema plenum*	Rough pigtoe	Clinch R	Aquatic-rivers	E	G1	SH	SH
1	-	X	*Pleurobema rubrum*	Pyramid pigtoe	Upper Clinch R	Aquatic-rivers	S	G2G3	SH	-
1	-	X	*Pleuronaia dolabelloides*	Slabside pearlymussel	Clinch R, M Fk Holston, N Fk Holston R	Aquatic-rivers	E	G2	S2	-
1	-	X	*Pleuronaia gibberum*	Tennessee pigtoe	Clinch R, Powell R, N Middle, S Fk Holston R	Aquatic-rivers	S	G2G3	S2	-
1	-	X	*Quadrula cylindrica strigillata*	Rough rabbits foot	Clinch R, Powell R, N Fk Holston R, Copper Ck	Aquatic-streams	E	G3G4T2	S2	-
1	-	X	*Quadrula intermedia*	Cumberland monkeyface	Powell R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Quadrula sparsa*	Appalachian monkeyface	Clinch R, Powell R	Aquatic-rivers	E	G1	S1	-
1	-	X	*Toxolasma lividus*	Purple lilliput	N Fk Holston R, Clinch R	Aquatic-rivers	S	G3Q	SH	-
1	-	X	*Villosa perpurpurea*	Purple bean	Clinch R, Copper Ck	Aquatic-rivers	E	G1	S1	-
1	-	X	*Villosa trabalis*	Cumberland bean	Clinch R	Aquatic-rivers	E	G1	SX	-
Spider (Arachnid)										
1	-	X	*Microhexura montivaga*	Spruce-fir moss spider	Mt Rogers	Damp, well-drained moss and liverwort mats on boulders in mature spruce-fir forests.	E	G1	S1	-
Pseudoscorpion (Arachnid, Order Pseudoscoriones)										
1	-	X	*Kleptochthonius orpheus*	Orpheus cave pseudoscorpion	Patton cave, Monroe Co, WV	Caves	S	G1	-	S1

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
Amphipod (Crustacean, Order Amphipoda)										
1	-	X	*Stygobromus abditus*	James Cave amphipod	James, Sam Bells caves, Pulaski Co; Watsons cave, Wythe Co; and other New River caves	Aquatic-caves, water well	S	G2G3	S2S3	-
1	-	X	*Stygobromus cumberlandus*	Cumberland cave amphipod	Lee, Scott, Wise Cos	Aquatic-caves	S	G3G4	S1S2	-
1	-	X	*Stygobromus estesi*	Craig County cave amphipod	Caves in Upper Sinking Ck Valley and Potts Ck, Poverty Hollow seeps, Captain seeps	Aquatic-caves, seeps	S	G4	S3	-
1	-	X	*Stygobromus fergusoni*	Montgomery County cave amphipod	Botetourt, Montgomery Cos	Aquatic-caves	S	G2G3	S1	-
1	X	-	*Stygobromus gracilipes*	Shenandoah Valley cave amphipod	Frederick, Rockingham, Shenandoah, Warren Cos	Aquatic-caves	S	G3G4	S2S3	S1
1	X	-	*Stygobromus hoffmani*	Alleghany County cave amphipod	Low Moor cave, Alleghany Co	Aquatic-caves, groundwater habitats including springs and seeps	S	G2	S2	-
1	X	-	*Stygobromus mundus*	Bath County cave amphipod	Alleghany, Bath Cos	Aquatic-caves	S	G2G3	S1S2	-
Isopod (Crustacean, Order Isopoda)										
1	-	X	*Caecidotea incurva*	Incurved cave isopod	McCullin Cave, Smyth Co; Groseclose Cave No. 1, Wythe Co	Aquatic-caves	S	G2G4	S2	-
1	X	X	*Miktoniscus racovitzai*	Racovitza's terrestrial cave isopod	Alleghany, Botetourt, Page, Rockbridge, Shenandoah Cos	Aquatic-caves	S	G3G4	S2	-
Millipede (Class Diplopoda)										
1	-	X	*Brachoria dentata*	A millipede	Known only from Pennington Gap and Cave Spring Recreation Area, Lee Co.	Leaf litter, deciduous forests.	S	G1	S1	-
1	-	X	*Brachoria eutypa ethotela*	Hungry Mother millipede	Pine Mtn above Troutdale	Leaf litter, deciduous forests.	S	G2	S2	-
1	-	X	*Buotus carolinus*	A millipede	Brush Mtn, Whitetop Mtn, Apple Orchard Mtn, Tazewell Beartown	Beech leaf litter, deciduous forests.	S	G3	S3	-
1	-	X	*Cleidogona hoffmani*	Hoffman's cleidogonid millipede	Mt Rogers, Whitetop Mtn, Elk Garden; Hamilton cave (private) Bland Co	Mountaintop species, leaf litter, deciduous forests.	S	G3	S2S3	-
1	-	X	*Cleidogona lachesis*	A millipede	Mt Rogers & Whitetop Mtn	Beech leaf litter, deciduous forests.	S	G2	S1	-
1	-	X	*Dixioria fowleri*	Fowler's millipede	Walker Mtn; Comers Rock on Iron Mtn; Laurel Ck, Damascas; 1/2 mile west of NRA office; Tazewell Beartown	Leaf litter, deciduous forests.	S	G2	S2	-
1	-	X	*Dixioria pela coronata*	A millipede	Endemic to Mt Rogers	Leaf litter, northern hardwood and spruce-fir forests. Altitudinally restricted, >5000'.	S	G2T2	S2	-
1	X	-	*Nannaria shenandoah*	Shenandoah Mountain xystodesmid millipede	One site: along Long Run Road, Rockingham Co.	Leaf litter, mixed oak forest.	S	G1	S1	-
1	X	-	*Pseudotremia alecto*	A millipede	Griffith Knob, Alleghany Co; near Mountain Grove Saltpetre Cave, Bath Co	Leaf litter, deciduous forests.	S	G1	S1	-
1	X	X	*Semionellus placidus*	A millipede	Hawksbill Mtn, Apple Orchard Mtn, Tomahawk Mtn	Leaf litter, deciduous forests.	S	G3	S2	-
Centipede (Insect, Order Chilopoda)										
1	X	X	*Escaryus cryptorobius*	Montane centipede	The Priest, Nelson Co; Whitetop Mtn, near junction of Grayson, Washington, Smyth Co	Upper soil horizon, spruce - birch forests.	S	G2	S2	-
1	-	X	*Escaryus orestes*	Whitetop Mountain centipede	Whitetop Mtn, near junction of Grayson, Washington, Smyth Co	Dark moist soil and litter, spruce - birch forests.	S	G1G2	S1S2	-
1	X	-	*Nampabius turbator*	A cave centipede	One known site: Low Moor cave, Alleghany Co	Caves	S	G1G2	S1	-
Springtail (Insect, Order Collembola)										
2	X	X	*Pygmarrhopalites carolynae*	A cave springtail	Augusta, Bath, Highland, Lee, Wise Cos	Caves	S	G4	S3	-
1	-	X	*Pygmarrhopalites commorus*	A cave springtail	Giles, Lee, Wise Cos	Caves	S	G2G3	S2S3	-
1	X	-	*Pygmarrhopalites sacer*	A cave springtail	Bath Co	Caves	S	G2	S2	-
Mayfly (Insect, Order Ephemeroptera)										
1	-	X	*Leptophlebia johnsoni*	Johnson's pronggill mayfly	One location: Lewis Fk north slope Mt Rogers	Aquatic-streams	S	G4	S1	-
Dragonfly, Damselfly (Insect, Order Odonata)										
1	X	X	*Gomphus viridifrons*	Green-faced clubtail	New R, Craig Ck, Pound R, Locust Spring	Aquatic-rivers	S	G3G4	S2	S2
1	-	X	*Ophiogomphus incurvatus alleghaniensis*	Allegheny snaketail	Rich Ck, Giles Co	Aquatic-streams	S	G3T2T3	S1	S1
1	-	X	*Acroneuria kosztarabi*	Virginia stonefly	Station Spring Ck, Tazewell Co	Aquatic-streams	S	G1G2	S1S2	-
1	-	X	*Isoperla major*	Big stripetail stonefly	Burkes Garden, Tazewell Co	Aquatic-streams	S	G1	S1	-
1	-	X	*Megaleuctra williamsae*	Smokies needlefly	Mt Rogers & Whitetop Mtn	Aquatic-streams	S	G2	S1S2	-
1	-	X	*Taeniopteryx nelsoni*	Cryptic willowfly	Lewis Fk & Grindstone Branch N of Mt Rogers	Aquatic-streams	S	G1	S1	-
Beetle (Insect, Order Cloeoptera)										
1	X	X	*Cicindela ancocisconensis*	Appalachian tiger beetle	Alleghany, Bath, Highland, Lee, Rockbridge, Washington, Wise Cos	Riparian - sandy/silty edges of streams and rivers.	S	G3	S2	S3
2	X	X	*Cicindela patruela*	Northern barrens tiger beetle	Blue Ridge, Ridge & Valley	Eroded slopes of exposed sandstone and conglomerate.	S	G3	S2	S2S3
1	-	X	*Cyclotrachelus incisus*	A ground beetle	Breaks Interstate Park, Dickenson Co	Dry, well drained site, red maple, magnolia, mountain laurel.	S	G4	S1	-
2	X	X	*Hydraena maureenae*	Maureen's hydraenan minute moss beetle	Alleghany, Bath, Botetourt, Bland, Craig, Cos	Interstitial water in riparian-shale substrate along stream edge.	S	G2?	S2?	-
Scorpionfly (Insect, Order Mecoptera)										

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
1	-	X	*Brachypanorpa jeffersoni*	Jefferson's short-nosed scorpionfly	Sugar Run Mountain, Giles Co; Whitetop Mtn, Smyth Co	Moist soil around seeps. Only known from high elevation. Larvae use short burrows in loose soil and moss.	S	G2	S1S2	-
Butterfly, Skipper, Moth (Insect, Order Lepidoptera)										
2	X	X	*Callophrys irus*	Frosted elfin	Frederick, Montgomery, Page, Roanoke Cos	Dry, open woods, clearings, and road/powerline ROWs with abundant wild indigo, *Baptisia tinctoria*.	S	G3	S2?	S1
2	X	X	*Speyeria diana*	Diana fritillary	Blue Ridge, Ridge & Valley	Grasslands-shrublands, near streams with thistles and milkweeds. Larval host plant, violets, *Viola* spp.	S	G3G4	S3	S2S3
2	X	X	*Speyeria idalia*	Regal fritillary	Blue Ridge, Ridge & Valley	Riparian, grasslands-shrublands. Larval host plant, violets, *Viola* spp.	S	G3	S1	S1
2	X	X	*Erynnis persius persius*	Persius duskywing	Blue Ridge, Ridge & Valley	Bogs, wet meadows, open seepages in boreal forests. Larval host plant, lupine, *Lupinus perennis*, wild indigo, *Baptisia tinctoria*.	S	G5T1T3	S1	-
2	X	-	*Pyrgus centaureae wyandot*	Appalachian grizzled skipper	Ridge & Valley	Shale barrens, open shaley oak woodlands. Larval host plant, cinquefoil, *Potentilla* spp, strawberry, *Fragaria virginina*.	S	G5T1T2	S1	S1
1	X	X	*Catocala herodias gerhardi*	Herodias underwing	Bald Knob, Bath Co; Poverty Hollow, Montgomery Co; Sand Mtn, Wythe Co (non FS property)	Pitch pine/bear oak scrub woodlands, >3000'. Larval host plant oak, *Quercus* spp.	S	G3T3	S2S3	SU
2	X	-	*Euchlaena milnei*	Milne's euchlaena moth	Warm Springs Mtn, Catawba Creek Slopes, Sweet Spring Hollow, Salt Pond Mtn. (Doe Creek)	Moist, forested slopes of mixed pine hardwoods. Acidic oak woods.	S	G2G4	S2	S2
1	X	-	*Psectrotarsia hebardi*	Hebard's noctuid moth	Bath Co	Rich, mesic hardwood forest. Larvae host plant, Canada horse-balm, *Collinsonia canadensis*.	S	GU	SH	-
NON-VASCULAR PLANT										
Lichen										
1	-	X	*Cetradonia linearis*	Rock gnome lichen	Whitop Mtn	Spruce-fir forests	E	G2	S1	-
2	X	X	*Hydrothyria venosa*	Hydrothyria lichen	Augusta, Amherst, Alleghany, Bedford, Botetourt, Giles, Highland, Madison, Nelson, Rockbridge, Shenandoah, Smyth, Wythe Cos VA; Pendleton Co WV	Aquatic - in streams/springs/cascades.	S	G4	S1	-
1	-	X	*Hypotrachyna virginica*	Virginia hypotrachyna lichen	Mt Rogers & Whitetop Mtn	Spruce-fir forests	S	G1G2	S1	SNR
Liverwort										
1	-	X	*Bazzania nudicaulis*	A liverwort	Mt Rogers & Whitetop Mtn	Bark and rock outcrops in spruce-fir forests.	S	G2G3	S?	-
1	-	X	*Frullania oakesiana*	A liverwort	Mt Rogers & Whitetop Mtn	Bark in spruce-fir forests.	S	G3?	S?	-
1	-	X	*Mertzgeria fruticulosa*	A liverwort	Whitetop Mtn	Bark in spruce-fir forests, >5000'.	S	G2Q	S?	-
2	-	X	*Nardia lescurii*	A liverwort	Blue Ridge, Ridge & Valley	Riparian - on peaty soil over rocks, usually in shade and associated w/ water, <3000'.	S	G3?	SU	-
1	-	X	*Plagiochila austinii*	A liverwort	Little Stony Ck – Cascades; Red Ck on Beartown Mtn	Rich, moist, densely forested ravines; shaded outcrops.	S	G3	S?	-
1	-	X	*Plagiochila sullivantii var. sullivantii*	A liverwort	Whitetop Mtn, Salt Pond Mtn	Moist shaded rock outcrops, under cliff ledges, in crevices.	S	G2T2	SNR	-
1	-	X	*Sphenolobopsis pearsonii*	A liverwort	Mt Rogers & Whitetop Mtn	Bark of Fraser fir, mountain ash, occasionally red spruce, >5000'.	S	G2	S?	-
Moss										
1	-	X	*Sphagnum flavicomans*	Northeastern peatmoss	Whitetop Mtn	Bogs, seeps	S	G3	SU	-
VASCULAR PLANT										
2	X	X	*Aconitum reclinatum*	Trailing white monkshood	Blue Ridge, Ridge & Valley	Rich cove sites, streambanks, seepages all with high pH.	S	G3	S3	S3
1	-	X	*Actaea rubifolia*	Appalachian black cohosh	Lower Clinch R watershed	Moist, rich wooded bluffs over limestone.	S	G3	S2	-
1	X	X	*Allium oxyphilum*	Nodding onion	Monroe, Summers, Mercer, Greenbrier Cos, WV	Shale barrens, sandstone glades.	S	G2Q	S1	S2
2	X	X	*Arabis patens*	Spreading rockcress	Frederick, Lee, Page, Shenandoah, Warren Cos	Shaded, calcareous cliffs, bluffs, and talus slopes.	S	G3	S2	S2
2	X	X	*Berberis canadensis*	American barberry	Blue Ridge, Ridge & Valley	Calcareous open woods, bluffs, cliffs, and along fencerows.	S	G3	S3S4	S1
1	-	X	*Betula uber*	Virginia round-leaf birch	One location: Cressy Ck, Smyth Co	Riparian, mixed open forest, usually disturbed sites.	T	G1Q	S1	-
2	X	-	*Boechera serotina*	Shale barren rockcress	Ridge & Valley N of James R watershed	Shale barrens and adjacent open oak woods.	E	G2	S2	S2
1	X	X	*Buckleya distichophylla*	Piratebush	Blue Ridge S of Roanoke R, Ridge & Valley S of James R	Open oak and hemlock woods.	S	G3	S2	-
1	-	X	*Cardamine clematitis*	Mountain bittercress	Blue Ridge, Ridge & Valley, S of New R watershed	Riparian, spring seeps, rocky streamsides.	S	G3	S1	-
1	-	X	*Cardamine flagellifera*	Blue Ridge bittercress	Blue Ridge, Ridge & Valley, S of New R watershed	Riparian, spring seeps, rocky streamsides.	S	G3	S1	S2
3	X	X	*Carex polymorpha*	Variable sedge	Blue Ridge, Ridge & Valley, N of James R	Open acid soil, oak-heath woodlands, responds positively to fire.	S	G3	S2	S1
2	X	X	*Carex schweinitzii*	Schweinitz's sedge	Augusta, Bath, Highland, Montgomery, Pulaski, Washington Cos	Bogs, limestone fens, marl marshes.	S	G3G4	S1	-
1	-	X	*Chelone cuthbertii*	Cuthbert turtlehead	Blue Ridge Plateau, Grayson, Carroll Cos	Bogs, wet meadows, boggy woods and thickets.	S	G3	S2	-
1	-	X	*Cleistesiopsis bifaria*	Small spreading pogonia	Craig, Dickenson, Scott, Wise Cos	Well drained, rather open, scrubby hillsides, oak-pine-heath woodlands, acidic soils.	S	G4?	S2	S1
1	-	X	*Clematis addisonii*	Addison's leatherflower	Montgomery, Roanoke, Botetourt, Rockbridge Cos	Open glades & rich woods over limestone and dolostone.	S	G1?	S1?	-
1	X	X	*Clematis coactilis*	Virginia white-haired leatherflower	Ridge & Valley, Rockbridge Co, S to Wythe Co	Shale barrens, rocky calcareous woodlands.	S	G3	S3	-
3	X	X	*Corallorhiza bentleyi*	Bentley's coralroot	Alleghany, Bath, Giles Cos VA; Monroe, Pocahontas Cos WV	Dry, acid woods, along roadsides, well-shaded trails.	S	G1G2	S1	S1

OAR	GW	J	Species Name	Common Name	Range on or near GWJNFs	Habitat - Detail	TES	GRank	VA SRank	WV SRank
2	X	X	*Delphinium exaltatum*	Tall larkspur	Blue Ridge, Ridge & Valley	Dry calcareous soil in open grassy glades or thin woodlands.	S	G3	S3	S2
2	X	-	*Echinodorus tenellus*	Dwarf burhead	Pines Chapel Pond, Augusta Co; Davidson Run Pond,	Pond margins, wet depressions in sandy soil.	S	G5?	S1	-
2	X	X	*Echinacea laevigata*	Smooth coneflower	Alleghany, Montgomery Cos	Open woodlands and glades over limestone or dolomite.	E	G2G3	S2	-
2	X	X	*Euphorbia purpurea*	Glade spurge	Blue Ridge, Ridge & Valley	Rich, swampy woods, seeps and thickets.	S	G3	S2	S2
1	-	X	*Gentiana austromontana*	Appalachian gentian	Mt Rogers, Whitetop Mtn, High Knob	High elevation forests and grassy balds. Southern Appalachian endemic.	S	G3	S3	S1
1	-	X	*Hasteola suaveolens*	Sweet-scented Indian-plantain	Giles, Montgomery, Pulaski Cos	Riverbanks, wet meadows.	S	G4	S2	S3
2	X	-	*Helenium virginicum*	Virginia sneezeweed	Endemic to Augusta, Rockingham Cos	Seasonally dry meadows and sinkhole depressions.	T	G3	S2	-
2	X	-	*Helonias bullata*	Swamp-pink	Augusta, Nelson Cos	Sphagnum bogs, seeps, and streamsides.	T	G3	S2S3	-
1	X	-	*Heuchera alba*	White alumroot	Shenandoah Mtn	High elevation rocky woods and bluffs.	S	G2Q	S2?	S2
2	X	X	*Hypericum mitchellianum*	Blue Ridge St. John's-wort	Blue Ridge, Ridge & Valley	Grassy balds, forest seepages, moderate to high elevations.	S	G3	S3	S1
2	X	X	*Ilex collina*	Long-stalked holly	Blue Ridge, Ridge & Valley	Bogs, seep, shrubby streamheads, >3100'.	S	G3	S2	S2
1	-	X	*Iliamna corei*	Peter's Mountain-mallow	One location: Narrows, Peters Mountain, Giles Co.	Rich, open woods along sandstone outcrops, soil pockets, fire maintained.	E	G1Q	S1	-
1	X	X	*Iliamna remota*	Kankakee globe-mallow	Alleghany, Botetourt, Rockbridge, Bedford Cos	Open, disturbed riverbanks and roadsides.	S	G1Q	S1	-
2	X	-	*Isoetes virginica*	Virginia quillwort	Augusta Co	Summer-dry sinkhole ponds, seasonally wet upland depressions, and small, wet-weather drains, especially in moss hummocks.	S	G1	S1?	-
2	X	X	*Isotria medeoloides*	Small whorled pogonia	In mountains of VA known only from Bedford, Craig, and Lee Cos; other VA occurrences in Piedmont & Coastal Plain	Open, mixed hardwood forests on level to gently sloping terrain with north to east aspect.	T	G2	S2	S1
2	X	X	*Juglans cinerea*	Butternut	Blue Ridge, Ridge & Valley	Well-drained bottomland and floodplain, rich mesophytic forests mostly along toeslopes.	S	G4	S3?	S3
2	X	X	*Liatris helleri*	Turgid gayfeather	Blue Ridge, Ridge & Valley	Shale barrens, mountain hillside openings.	S	G3	S3	S2
1	-	X	*Lilium grayi*	Gray's lily	Blue Ridge, Mt Rogers & Whitetop Mtn (occurrences north of Floyd Co questionable)	Bogs, open seeps, wet meadows, grassy balds.	S	G3	S2	-
1	X	-	*Lycopodiella margueritae*	Marguerite's clubmoss	Bath Co	Seasonally moist soils, wet acidic ditches, borrow pits.	S	G2	NA	-
1	-	X	*Micranthes caroliniana*	Carolina saxifrage	Blue Ridge, Ridge & Valley, S of New R	Moist, shaded rocks and cliffs.	S	G3	S3	S1
6	X	X	*Monotropsis odorata*	Sweet pinesap	Blue Ridge, Ridge & Valley	Dry oak-pine-heath woodlands, soil usually sandy.	S	G3	S3	S1
1	-	X	*Packera millefolium*	Piedmont ragwort	Lee, Scott Cos	Open limestone outcrops and cedar barrens.	S	G2	S2	-
1	X	-	*Paxistima canbyi*	Canby's mountain lover	Ridge & Valley, Sarver Barrens SBA, Craig Co	Calcareous cliffs and bluffs, usually undercut by stream.	S	G2	S2	S2
3	X	X	*Phlox buckleyi*	Sword-leaf phlox	Blue Ridge, Ridge & Valley	Open, often dry oak woodlands and rocky slopes, usually over shale in humus rich soils, often along roadsides.	S	G2	S2	S2
2	X	X	*Poa paludigena*	Bog bluegrass	Blue Ridge, Ridge & Valley	Shrub swamps and seeps, usually under shade.	S	G3	S2	S1
2	X	-	*Potamogeton hillii*	Hill's pondweed	Bath Co	Clear, cold calcareous ponds.	S	G3	S1	-
2	X	-	*Potamogeton tennesseensis*	Tennessee pondweed	Ridge & Valley	Ponds, back water of streams and rivers.	S	G2G3	S1	S2
1	-	X	*Prenanthes roanensis*	Roan Mountain rattlesnake-root	Mt Rogers & Whitetop Mtn	Grassy balds, open high elevation forests and outcrops.	S	G3	S3	-
1	X	X	*Pycnanthemum torrei*	Torrey's mountain-mint	Bland, Bath, Giles, Rockbridge, Wythe Cos	Open, dry rocky woods, roadsides, and thickets near streams, heavy clay soil over calcareous rock.	S	G2	S2?	S1
1	-	X	*Rudbeckia triloba var. pinnatiloba*	Pinnate-lobed coneflower	Giles, Montgomery, Smyth, Wise Cos	Dry calcareous soil of open woods and roadsides.	S	G5T3	S1	-
1	-	X	*Sceptridium jenmanii*	Alabama grapefern	Scott, Russell, Wise Cos	Open woods, old fields, pastures.	S	G3G4	SH	-
2	X	X	*Scirpus ancistrochaetus*	Northeastern bulrush	Ridge & Valley	Mountain ponds, sinkhole ponds in Shenandoah Valley.	E	G3	S2	S1
3	X	X	*Scutellaria saxatilis*	Rock skullcap	Blue Ridge, Ridge & Valley	Rich, dry to mesic ridgetop woods, 32 counties in VA, likely G4/S4.	S	G3	S3	S2
2	X	X	*Sida hermaphrodita*	Virginia mallow	Ridge & Valley, James R watersheds	Riverbank glades with loose rock or sandy soil.	S	G3	S1	S3
1	-	X	*Silene ovata*	Mountain catchfly	Dickenson, Lee, Wise Cos	Rich woodlands and forests over limestone.	S	G3	S1	-
1	-	X	*Spiraea virginiana*	Virginia spiraea	Blue Ridge, Ridge & Valley, S of New R	Scoured banks of streams, riverside or island shrub thickets.	T	G2	S1	S1
2	X	-	*Trillium pusillum var. moniticulum*	Virginia least trillium	Great North Mtn & Shenandoah Mtn, VA and WV	Open oak woodlands in well drained soil and margins of thickets at higher elevations.	S	G3T2	S2	S1
1	-	X	*Tsuga caroliniana*	Carolina hemlock	Blue Ridge north to James R.	Rocky ridges and slopes, usually dry and well drained.	S	G3	S3	-
2	X	X	*Vitis rupestris*	Sand grape	Ridge & Valley	Scoured banks of rivers and streams over calcareous bedrock.	S	G3	S1?	S2

LEGEND FOR TES SPECIES LIST IN OCCURRENCE ANALYSIS RESULTS:

OAR CODES:

1 = Project located out of known species range.
2 = Lack of suitable habitat for species in project area.
3 = Habitat present, species was searched for during field survey, but not found.
4 = Species occurs in project area, but outside of activity area.
5 = Field survey located species in activity area.
6 = Species not seen during field survey, but possibly occurs in activity area based on habitat observed. or Field survey not conducted when species is recognizable (time of year or time of day). Therefore assume presence and no additional surveys needed.
7 = Aquatic species or habitat known or suspected downstream of project/activity area, but outside identified geographic bounds of water resource cumulative effects analysis area (defined as point below which sediment amounts are immeasurable and insignificant).
8 = Aquatic species or habitat known or suspected downstream of project/activity area, but inside identified geographic bounds of water resource cumulative effects analysis area.
9 = Project occurs in a 6th level watershed included in the USFWS/FS T&E Mussel and Fish Conservation Plan (August 8, 2007 U.S. Fish & Wildlife Service concurrence on updated watersheds). Conservation measures from the USFWS/FS T&E Mussel and Fish Conservation Plan applied.

SPECIES: The term "species" includes any subspecies of fish, wildlife or plants, and any distinct population segment of any species or vertebrate fish or wildlife, which interbreeds when mature (Endangered Species Act of 1973, as amended through the 100th Congress).

RANGE: The geographical distribution of a species. For use here "range" is expressed as where a species is known or expected to occur on or near the George Washington and Jefferson National Forests in terms of landform (feature name, physiographic province), political boundary (county name), or watershed (river, or stream name).

HABITAT: A place where the physical and biological elements of ecosystems provide a suitable environment and the food, cover and space resources needed for plant and animal livelihood (FSM 2605-91-8, pg. 10 of 13).

TES CODES:

T = Federally listed as Threatened
E = Federally listed as Endangered
P = Federally Proposed as T or E
S = Southern Region (R8) Sensitive species

GLOBAL RANK: Global ranks are assigned by a consensus of the network of natural heritage programs, scientific experts, NatureServe and The Nature Conservancy to designate a rarity rank based on the range-wide status of a species or variety. This system was developed by The Nature Conservancy and is widely used by other agencies and organizations as the best available scientific and objective assessment of taxon rarity and level of threat to its existence. The ranks are assigned after considering a suite of factors including number of occurrences, numbers of individuals, and severity of threats.

G1 = Extremely rare and critically imperiled with 5 or fewer occurrences or very few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.
G2 = Very rare and imperiled with 6 to 20 occurrences or few remaining individuals; or because of some factor(s) making it especially vulnerable to extinction.
G3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range; or vulnerable to extinction because of other factors. Usually fewer than 100 occurrences are documented.
G4 = Common and apparently secure globally, although it may be rare in parts of its range, especially at the periphery.
G5 = Very common and demonstrably secure globally, although it may be rare in parts of its range, especially at the periphery.
GH = Formally part of the world's biota with the exception that may be rediscovered.

GX = Believed extinct throughout its range with virtually no likelihood of rediscovery.
GU = Possibly rare, but status uncertain and more data needed.
G? = Unranked, or, if following a ranking, ranking uncertain (ex. G3?).
G_Q = Taxon has a questionable taxonomic assignment, such as G3Q.
G_T = Signifies the rank of a subspecies or variety. For example, a G5T1 would apply to a subspecies of a species that is demonstrably secure globally (G5) but the subspecies warrants a rank of T1, critically imperiled.

STATE RANK: The following ranks are used by the Virginia Department of Conservation and Recreation to set protection priorities for natural heritage resources. Natural Heritage Resources (NHRs) are rare plant and animal species, rare and exemplary natural communities, and significant geologic features. The criterion for ranking NHRs is the number of populations or occurrences, i.e. the number of known distinct localities; the number of individuals in existence at each locality or, if a highly mobile organism (e.g., sea turtles, many birds, and butterflies), the total number of individuals; the quality of the occurrences, the number of protected occurrences; and threats.

- **S1** - Extremely rare; usually 5 or fewer populations or occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.
- **S2** - Very rare; usually between 6 and 20 populations or occurrences; or with many individuals in fewer occurrences; often susceptible to becoming extirpated.
- **S3** - Rare to uncommon; usually between 21 and 100 populations or occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
- **S4** - Common; usually >100 populations or occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- **S5** - Very common; demonstrably secure under present conditions.
- **SA** - Accidental in the state.
- **S#B** - Breeding status of an organism within the state.
- **SH** - Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- **S#N** - Non-breeding status within the state. Usually applied to winter resident species.
- **SR** – Reported for Virginia, but without persuasive documentation that would provide a basis for either accepting or rejecting the report.
- **SU** - Status uncertain, often because of low search effort or cryptic nature of the element.
- **SX** - Apparently extirpated from the state.
- **SZ** - Long distance migrant, whose occurrences during migration are too irregular, transitory and/or dispersed to be reliably identified, mapped and protected.
- **NA** – Not Applicable- A conservation status rank in not applicable because the species is not a suitable target for conservation activities.

These ranks should not be interpreted as legal designations.